Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

JANUARY, 1957

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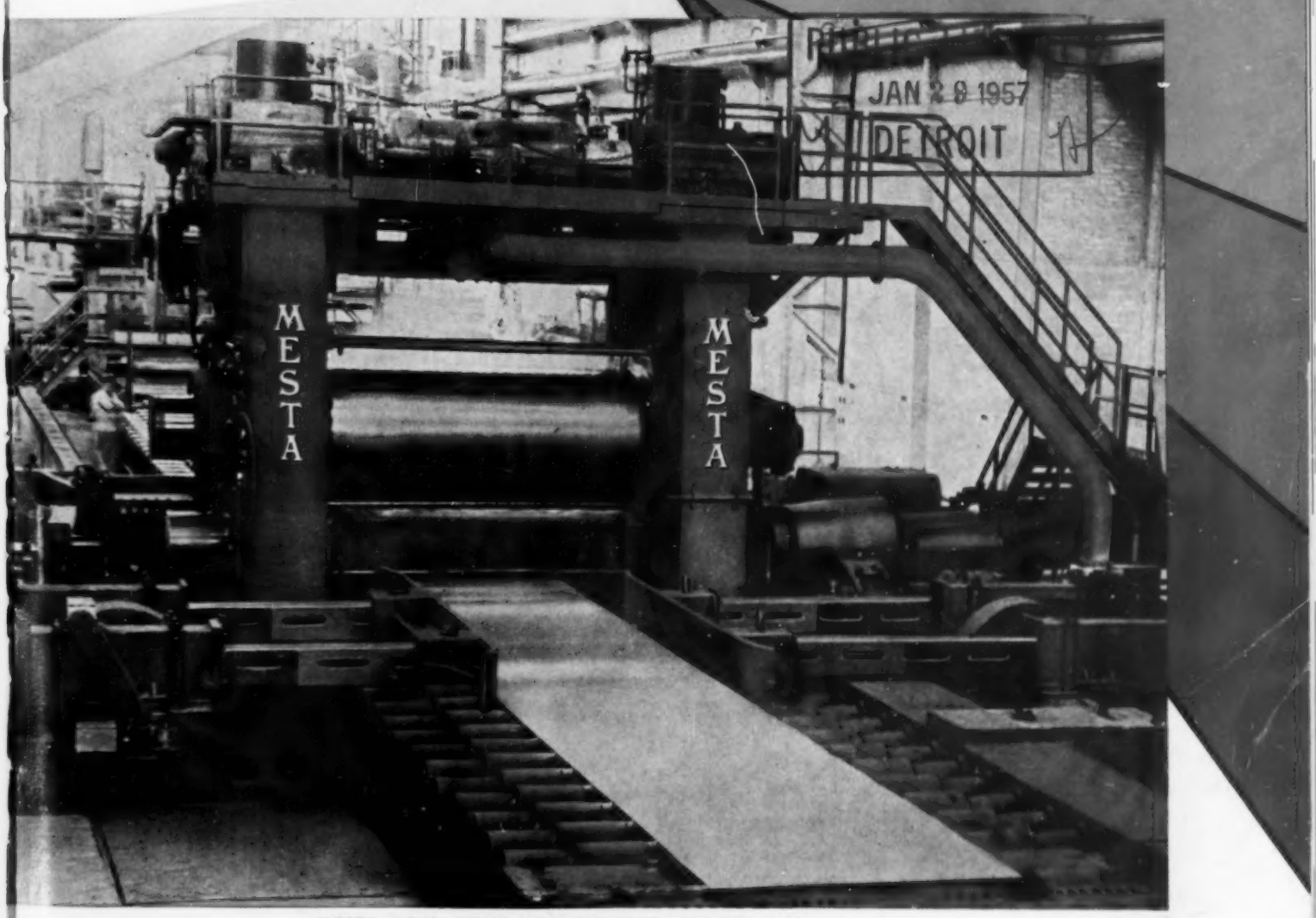
TECHNOLOGY DEPT.

PLATE MILLS

Designed and Built by MESTA



MESTA 132" FOUR-HIGH REVERSING PLATE MILL

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

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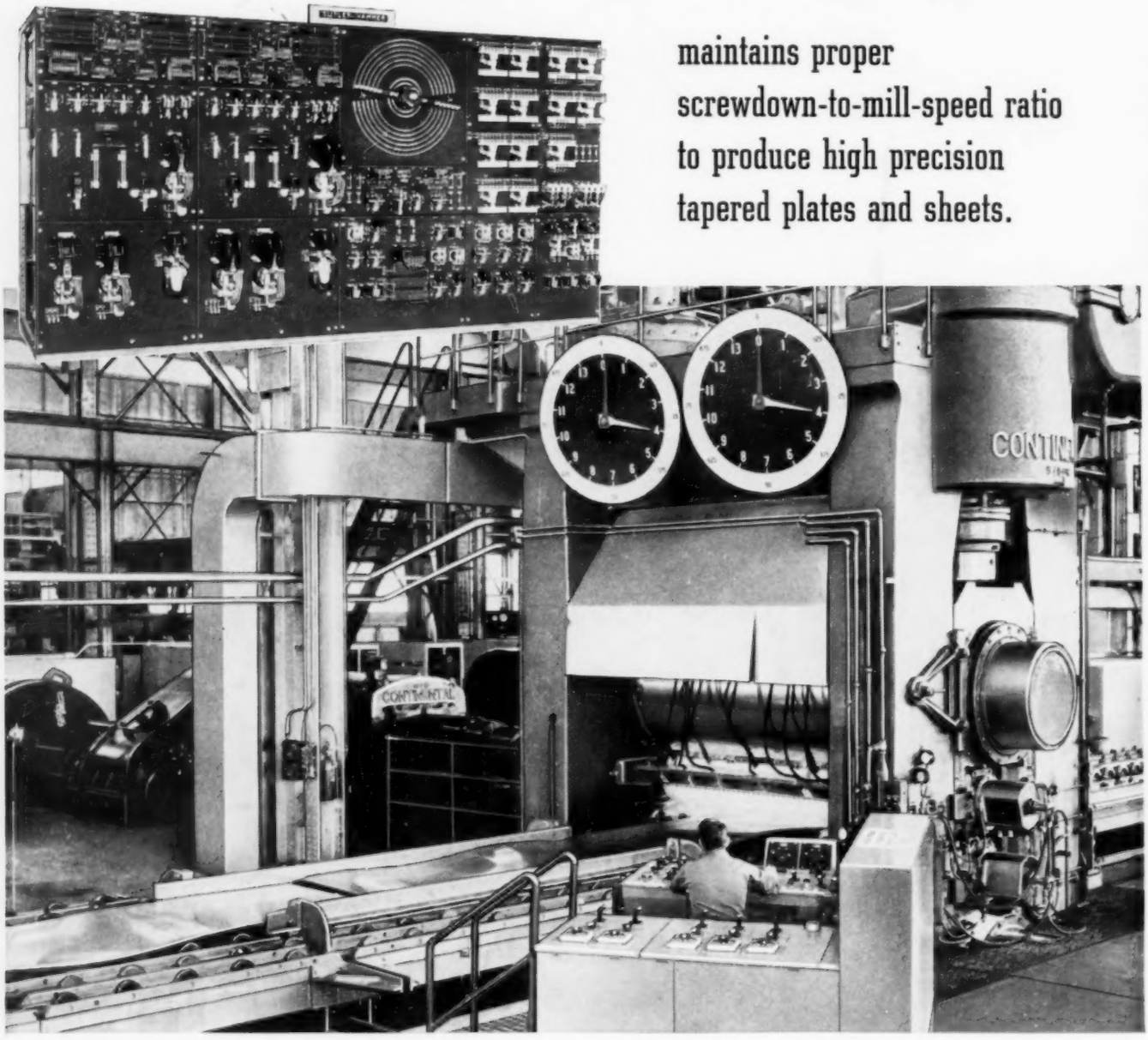
Cutler-Hammer Control at Alcoa-Davenport



maintains proper screwdown-to-mill-speed ratio to produce high precision tapered plates and sheets.

The feature that distinguishes ALCOA's 144" four-high plate mill at Davenport is its ability to roll tapered plates and sheets to the highest degree of uniformity, precision and accuracy.

The performance of the mill in this respect is a function of the Cutler-Hammer Motor Control governing the screwdown drive and achieving and maintaining the specified taper *even during transient variations in mill speed.* Cutler-Hammer's long experience produced a control scheme embodying magnetic amplifiers, which on the one hand provides the needed sensitivity and fast response . . . and on the other hand great simplicity and dependability.

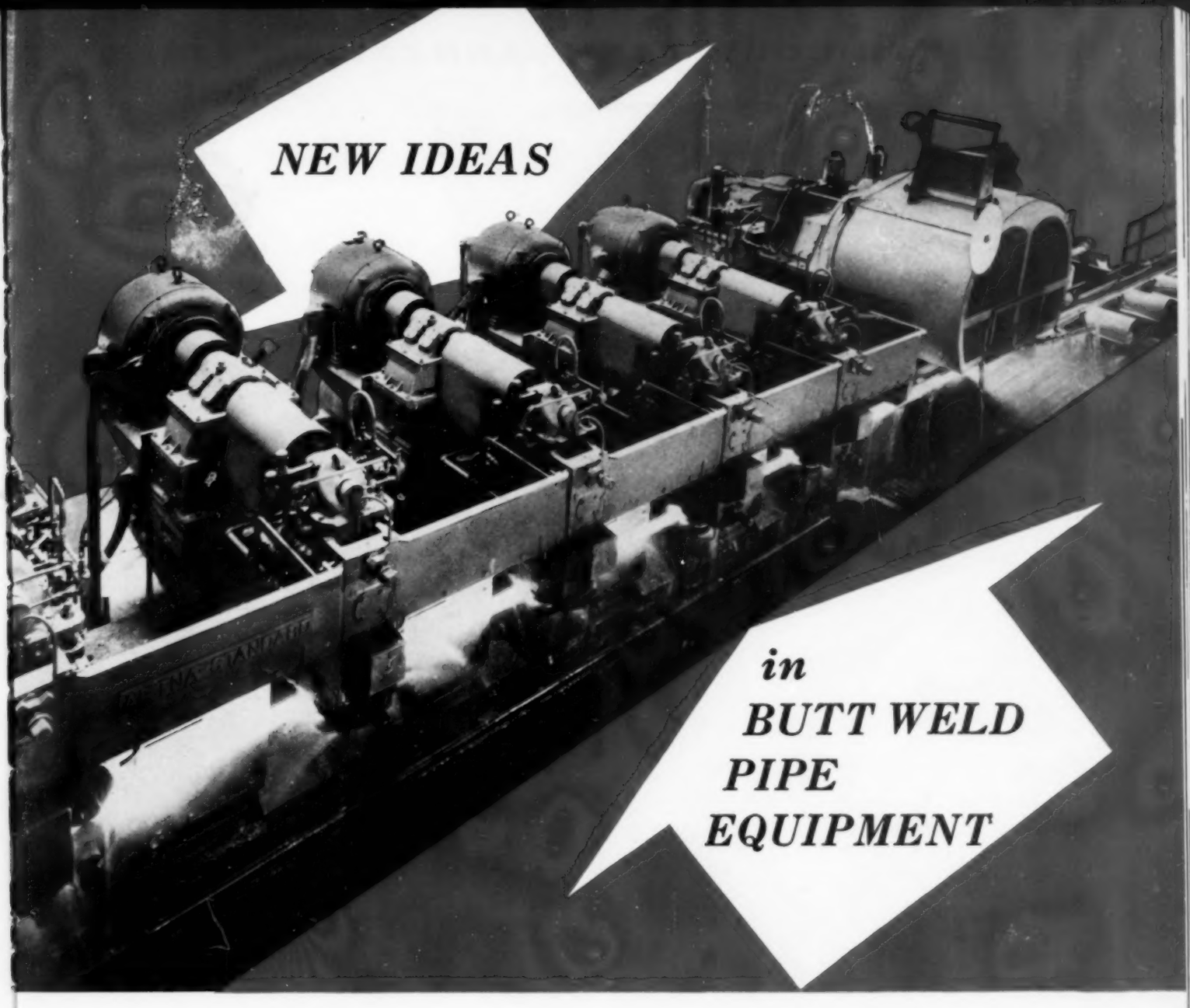
CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

CUTLER-HAMMER
MOTOR CONTROL
C-H

TECH

LOOK TO CUTLER-HAMMER MILL EXPERIENCE . . . AS BROAD AS IT IS LONG

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers at 20th and Northampton Sts., Easton, Pa. Editorial and advertising offices, 1010 Empire Bldg., Pittsburgh 22, Pa. Entered as second class matter at Pittsburgh, Pa., and application for re-entry as second class matter at Easton, Pa., pending.



UNCOILER-LEVELLER . . . Equipment includes automatic handling, weighing, storage, and uncoiling of coiled skelp ahead of flash welder. One man operation. Improved leveller has skelp deflector roll, adjustable independent of leveller roll bank.

ROTARY FLYING HOT SAW . . . Saw adjustments can be made to select any cutting length without reducing delivery speed from mill. Saw adjustment permits cutting single pipe lengths from 18 feet to 60 feet.

AUTOMATIC PIPE SELECTOR releases pipe at predetermined intervals. Controls gap between consecutive lengths of pipe. Eliminates overlapping of pipes as they enter Straightener. Eliminates need for operator to regulate continuous flow of pipe.

TRAVELING CRADLES facilitate removal of crane lifts of pipe from the line of production to maintain full mill efficiency.

POSITIVE TRANSFER of pipe from Screw Type Kickoff, following Sizing Mill, to Screw Type Cooling Bed.

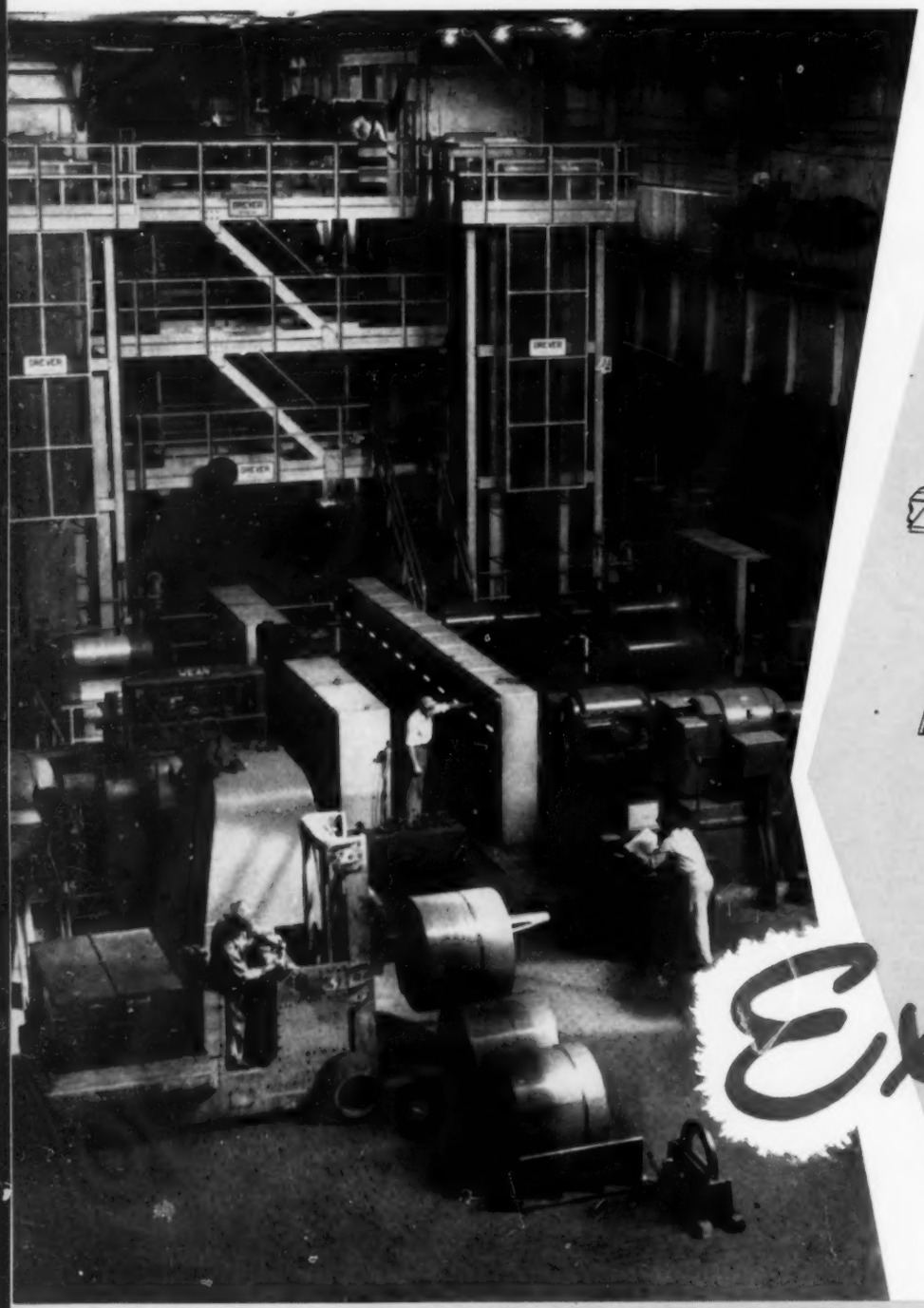
AETNA • STANDARD

THE AETNA-STANDARD ENGINEERING COMPANY

GENERAL OFFICES: PITTSBURGH, PA. **PLANTS: ELLWOOD CITY, PA., WARREN, OHIO**

CONTINUOUS GALVANIZING LINES • CONTINUOUS ELECTROLYTIC TINNING LINES • SIDE TRIMMING AND SHEAR LINES AND OTHER FINISHING EQUIPMENT • CONTINUOUS BUTT WELD PIPE MILLS • SEAMLESS TUBE MILLS • DRAWBENCHES AND OTHER COLD DRAW EQUIPMENT • ROLLS AND CASTINGS • EXTRUDERS, MILLS, PRESSES FOR RUBBER AND PLASTIC

WEAN CONTINUOUS STRIP ANNEALING LINES



WHEN *Experience* COUNTS

Two of five Wean Continuous Strip Annealing Lines installed in a Pittsburgh district mill.

Ninth Wean Engineered Line Sets New Record

The ninth Wean designed continuous strip annealing line for silicon and tinplate products is now in the process of construction. This means that Wean has engineered more of these lines than all other firms combined — a record in every sense of the word.

The reasons for this Wean leadership are many. For example, the Wean design permits maximum speed and production while providing an excellent bright annealed product of uniform surface. And, users of Wean continuous lines report better metallurgical control, better temper mill operation with elimination of stickers, better delivery and a reduction in process inventory.

★ Wean also has designed and built 11 Stainless Steel Continuous Annealing Lines — also a record in the industry.

58

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Iron AND Steel ENGINEER

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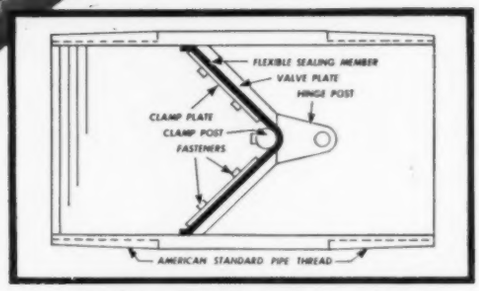
NOW A UNIQUE MULTI-PURPOSE CHECK VALVE



SILENT • SEATLESS • LOW PRESSURE DROP

Technocheck©-MP

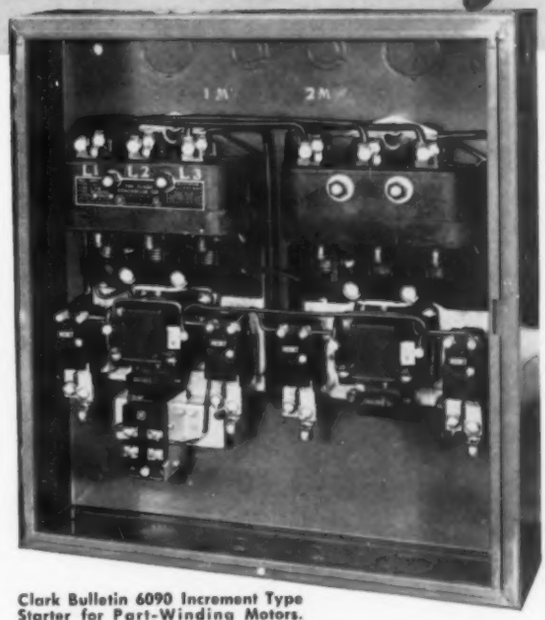
OUTPERFORMS • OUTWEARS OTHER VALVES • COSTS LESS TO MAINTAIN

Technocheck-MP is a highly efficient check valve that has a wide range of industrial applications. Its unique design eliminates the need for valve seats and permits use in low or high pressure service. Tight sealing, low pressure drop across valve and long life with low upkeep are Technocheck-MP characteristics. Valves are produced in numerous metals and alloys as well as in polyvinyl chloride for use in PVC piping systems. They are made in standard or custom designs, and in threaded or flanged ends.

Write for Bulletin

Techno Corporation
16 West 5th Street, Erie, Pa.

Two Outstanding CLARK CONTROLS for *"Cushioned" Motor Starting*



Clark Bulletin 6090 Increment Type Starter for Part-Winding Motors. Integral Hinged Cover not shown.

CLARK Increment Starters for Part-winding Motors and CLARK Reduced Voltage, Primary-resistor Type Starters are ideal for providing "cushioned" acceleration where requirements of the mechanical or electrical system indicate reduced torque-and-current starting. Both types offer the advantage of smoother acceleration and power application since the motor is not disconnected—eliminating mechanical and electrical shocks on the second step of acceleration. Both are available in sizes 1 through 7, with sizes 4 and smaller using the famous Clark Type "CY" starters which are setting new standards for dependability, low maintenance, and long life. Compact enclosures feature "safe-edge" design and generous wiring space.

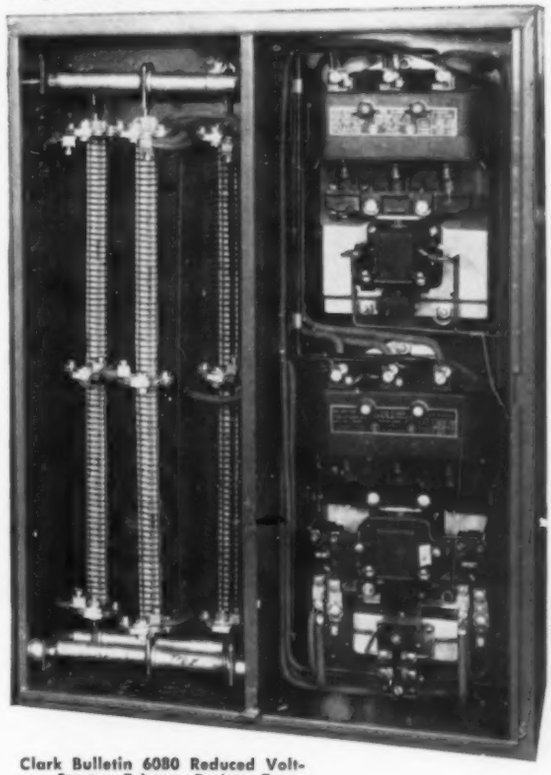
CLARK INCREMENT STARTERS FOR PART-WINDING MOTORS

Where part-winding motors can be used, this starter offers definite economical advantages. Because it has no resistors and uses smaller size contactors, a single compact enclosure reduces space requirements, and the initial cost is low compared to other types.

CLARK PRIMARY-RESISTOR TYPE REDUCED VOLTAGE STARTERS

This starter is applicable where higher starting torque is required. It offers greater flexibility of starting requirements and can be used on any squirrel-cage motor. It features the CLARK Edgewound non-breakable resistors—contactors and resistors are mounted in isolated compartments—where both are readily accessible.

For complete information on Clark Controls for "Cushioned" Starting, contact your nearest Clark sales office or Clark distributor, or write us direct.



Clark Bulletin 6080 Reduced Voltage Starter—Primary Resistor Type. Integral Hinged Cover not shown.

The **CLARK CONTROLLER** *Company*

Everything Under Control

1146 East 152nd Street • • Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

For improved O-H combustion practice...

Record O_2 Reliably, Heat after Heat

Key to continuous, reliable records of oxygen in open-hearth exhaust gases is the unique L&N sampling system. Self-flushing, self-cleaning, this assembly delivers a thoroughly scrubbed sample of waste gas to the L&N Magnetic Oxygen Analyzer under positive pressure, without mechanical pumps or aspirators . . . and with very little maintenance.

Spray-flushing of the probe opening and internal passages prevents slag buildup and dirt accumulation. The sample gas is drawn from the water-jacketed, stainless steel probe by a steam jet assembly. Expansion of steam accelerates the gas to a high velocity; condensation of the steam scrubs the sample by precipitating all dust and dirt. The cleaned sample travels at 50 ft./sec. in the sampling lines (quarter-inch copper tubing), so that initial response of the *entire* system is only about 10 seconds.

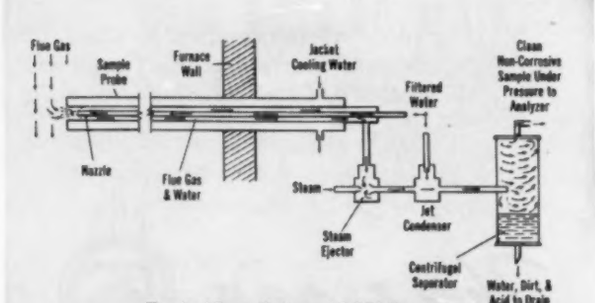
The Magnetic Oxygen Analyzer and the Speedomax G® recorder, calibrated directly in per cent O_2, may be located wherever convenient . . . are quickly checked against air to assure accurate performance.

Complete description of this equipment is contained in Process Data Sheet 643(5), available from your nearest L&N representative. Or write us at 4942 Stenton Avenue, Philadelphia 44, Pa.

LEEDS NORTHRUP
Instruments — Automatic Controls • Furnaces

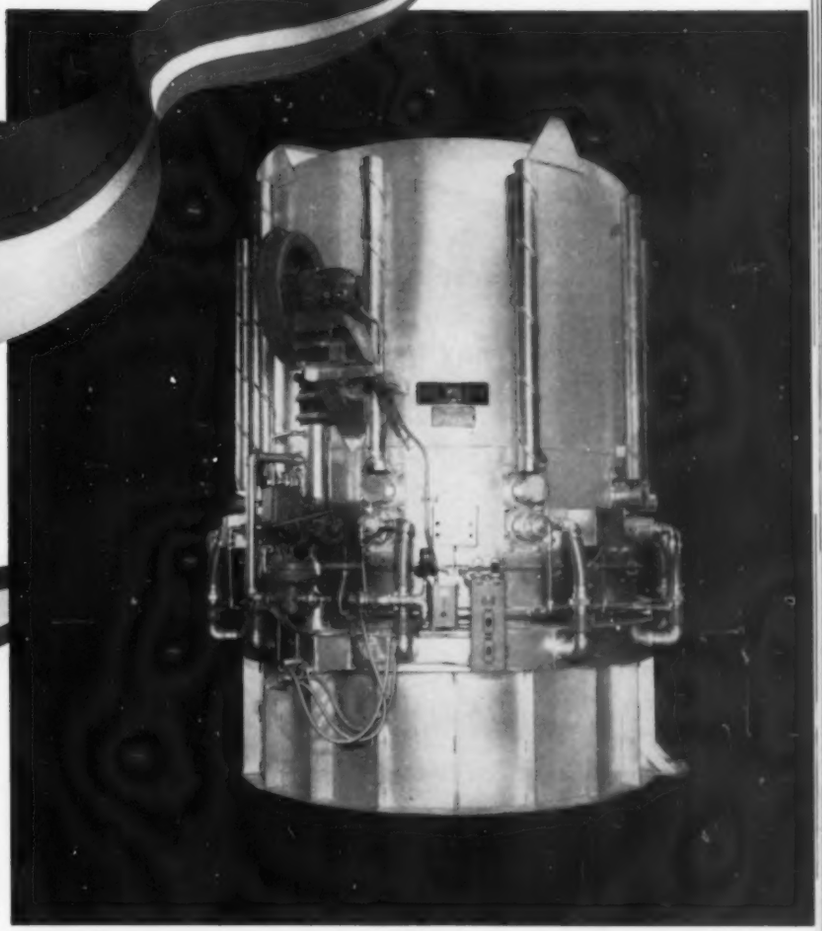
In this O-H shop of Jones & Laughlin Steel Corp., Pittsburgh, the L&N O_2 Analyzer is used with a Speedomax G Controller, which adjusts a fuel-air controller (not shown) to provide automatic combustion control.

Schematic of Open-Hearth Flue-Gas Sampling for L&N Oxygen Analyzer



Typical Installation of L&N Oxygen Recorder for O-H Flue Gas Analysis

They passed the test with colors flying...



Leading steel producers are turning Pilot Single Stack Setups into production installations

Last year, more Lee Wilson Single Stack coil annealing furnaces were set into operation than ever before. These included many pilot installations where Single Stack furnaces had been under close observation for long periods of time. Users found that the Single Stack units permitted them to operate with far less process inventory and that they could get better quality, faster at less cost.

Today the Lee Wilson Single Stack furnace is the "hottest" item in the annealing field — it has passed the test with flying colors — and is destined to become the standard of the industry.

	STARTED	ADDED	TOTAL
COMPANY A	1	29	30
COMPANY B	1	24	25
COMPANY C	4	14	18
COMPANY D	1	9	10
COMPANY E	2	42	44

Lee Wilson ENGINEERING COMPANY, INC.

20005 WEST LAKE ROAD • CLEVELAND 16, OHIO

SINGLE-STACK RADIANT TUBE ANNEALING FURNACES

MAKE THE BEST METALS BETTER

* ORIGINATORS AND LEADING PRODUCERS OF SINGLE-STACK RADIANT TUBE FURNA

5 miles--27

RALPH CARLSON
General Manager
22 Years

H. D. SANDY
North District Sales Manager
19 Years

H. R. CLARK
Chief Engineer
25 Years

when you need help on bearing problems

BERRY BEARING COMPANY
old timers like these--are at your service
Any time
Any day
Any hour

All together, Berry old timers have over 809 years combined bearing know-how to draw on in helping solve bearing problems

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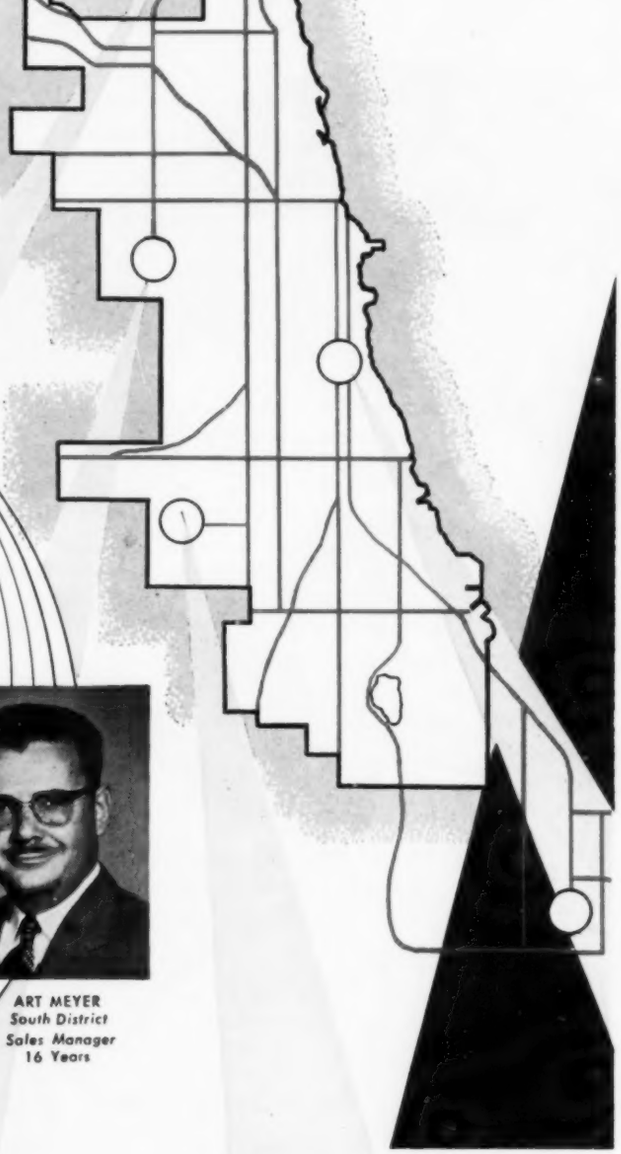
Automotive Sales Manager
14 Years

BEN SABAL
Purchasing Agent
31 Years

ART MEYER
South District Sales Manager
16 Years

LARRY CARLSON
Service Manager
27 Years



BERRY

SKOKIE
[illegible] Oakton St.
[illegible]ard 4-6600

OAK PARK
[illegible] Madison St.
[illegible]id 6-1700

SOUTHWEST
[illegible] W. Archer Ave.
Lyndale 5-4400

minutes

Regardless of your address--you're now no more than 5 miles away from one of Berry Bearing Company's six, strategic locations in the Chicago area.

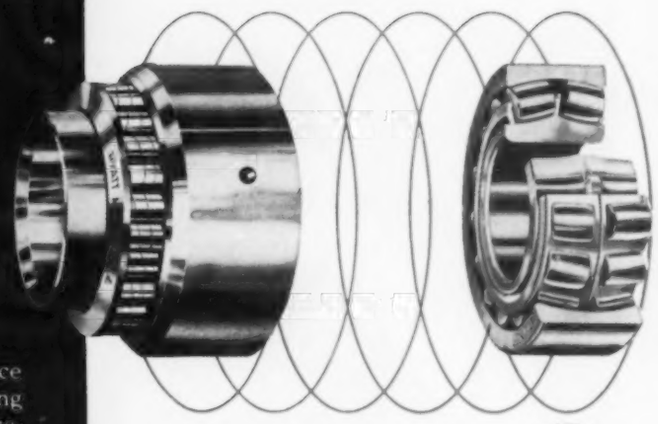
And, regardless of what type or size of bearing or bearing specialty you need--Berry can give you delivery in approximately 27 minutes, or less.

A daring, far-sighted dream of the utmost in customer service became a highly successful reality with the recent opening of Berry Bearing Company's new...and *sixth*...Chicagoland location--at 4438 Oakton Street, Skokie, Illinois.

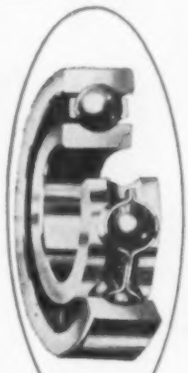
This new Skokie location practically completes the chain of city-wide distributing points...and...puts Berry no more than 5 miles and 27 minutes away from your receiving department.

Thus, as authorized stock carrying distributor for 41 of the nation's leading manufacturers of bearings and bearing specialties--Berry can quickly furnish you with any brand, type, or size you require. And, more than 160 employees are on the job--to put your order through in a hurry. All of which adds up to--immediate delivery. With such a dependable source of supply you can cut your bearing inventory to the minimum--and save time, space, and money.

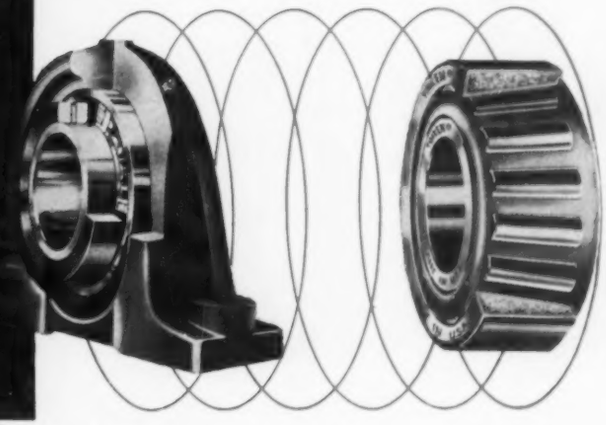
Remember, when you reach for your phone and order from Berry, one of the largest bearing distributors in the United States, you will always get what you want with super-service plus--all for the price of the bearings.



all types
all sizes
of
BEARINGS
and
BEARING
SPECIALTIES
are ready for
IMMEDIATE
DELIVERY



More than 22 miles of stock room shelves are used to store over 50,000 items that Berry regularly carries in stock.



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26[illegible] S. Michigan Ave.
[illegible]nube 6-6800

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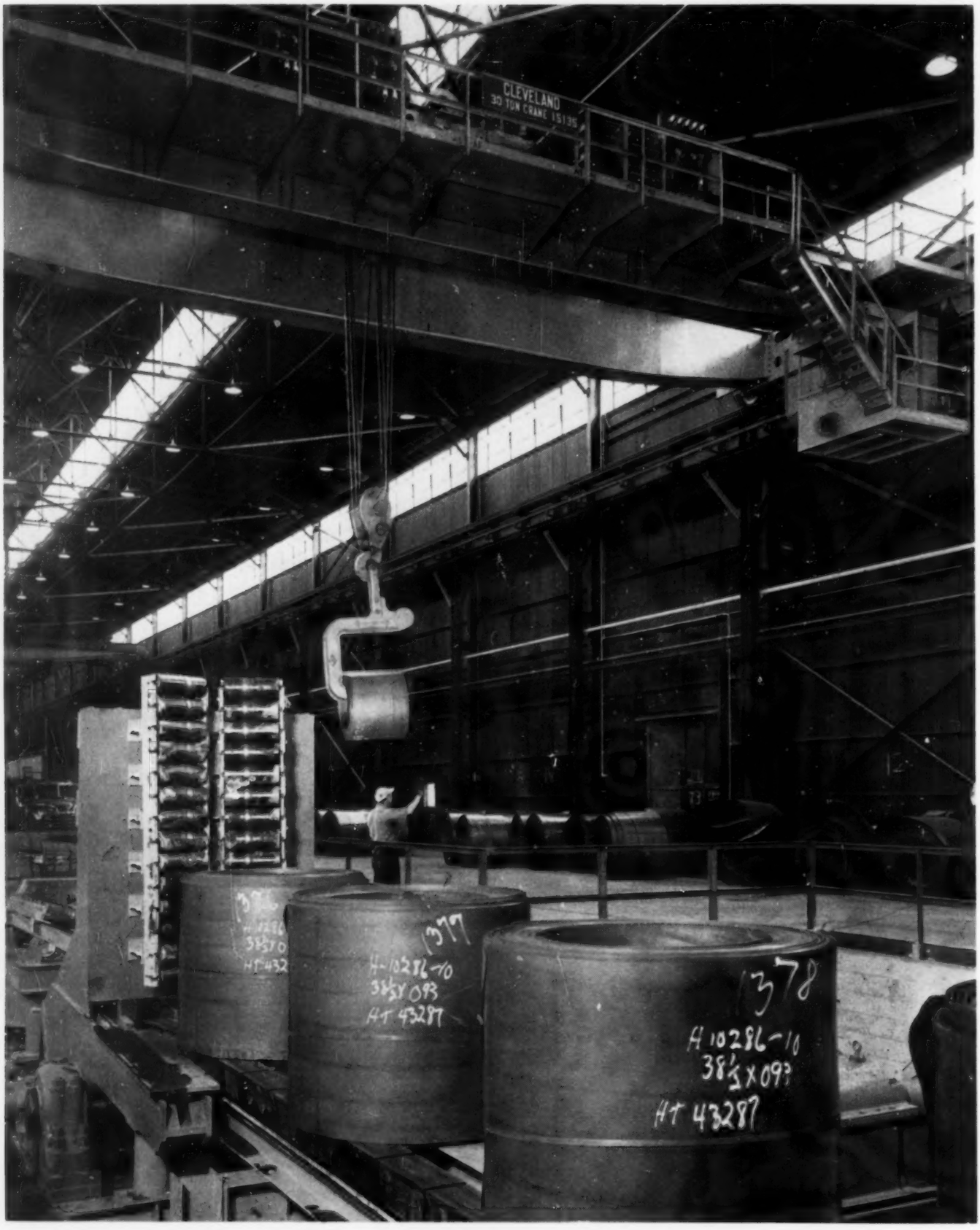
4[illegible] Calumet Ave.
[illegible] 3010

GARY
[illegible]6 E. 5th Ave.
[illegible]ner 5-7501



CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

NOW that we've survived the holidays we can settle down and go to work with nothing to bother us—except income tax time and Christmas bills. Speaking of the latter, a friend of ours thinks it would be nicer if they could be paid in two months—say June 1957 and August 1960.

Guess this is the month when check books should be included among books with unhappy endings.

▲

THE chap next door says Christmas gifts are of two classes—those you don't like and those you don't get.

▲

YEAR-end statements from a number of steel executives predict a full year of steel production ahead, probably with a new tonnage record. These predictions are most optimistic than some previous forecasts which visioned a drop-off in the last half of the year.

▲

A 40-lane bowling alley to be built in Texas will have a glassed-in crib area for infants. One-way glass will permit the parents to see the babies but the kids won't be able to see the parents.

Separating the bowling from the bawling?

▲

STARTING salaries for engineering graduates is averaging about $4700, some 14 per cent above 1954. This increase is probably as much as the 1954 graduates have enjoyed since they started work. This telescoping of salary levels is causing discontent among young engineers and encouraging them to look speculatively at the possibilities of unionism. It is reported that 60,000 of the 500,000 or more professional engineers in the United States are now in unions. The common gripes seem to be insufficient salary spread between engineers and nonprofessional workers (since 1929, wages have trebled, salaries doubled) and the feeling that engineers are treated much the same as nonprofessional workers.

▲

MAYBE it will surprise you as much as it did us to learn that the largest circulation paper in the United States (listed as the New York Daily News, 2,100,000 per day) ranks eighth in the world. It is surpassed by two Tokyo papers, three London papers, a Moscow paper and a Hamburg paper.

SYRACUSE University and University College are starting a program of six-year courses in engineering, providing a complete undergraduate schedule on a part-time basis. The first two years of a regular course are spread over four years to permit students to maintain a full working schedule with their employers while completing regular freshman and sophomore work. Students completing the four years may stop there with an associate degree in engineering or they may complete requirements for a bachelor's degree by full-time attendance at a university of their choice.

▲

THE Houghton Line tells of a new employee who complained that he didn't know what time the office opened, because they were always working when he got there.

▲

GEIGER counters may become standard equipment for golfers if the idea of golf balls containing radioactive material is adopted.

▲

THEODORE OTTEN, of Staten Island, N. Y., is a victim of our modern way of life. Mr. Otten worked for the Staten Island Transit Company and had, for many years, been a member of his union as well as various societies. In 1948 he joined a religious group and, in accordance with their principles, resigned from all other organizations, including his union. With the advent of a union-shop clause, Mr. Otten was in trouble and in 1952 was discharged. Since then, the case has gone through the courts to no avail. He cannot have his job back without changing his religious beliefs.

This is freedom?

▲

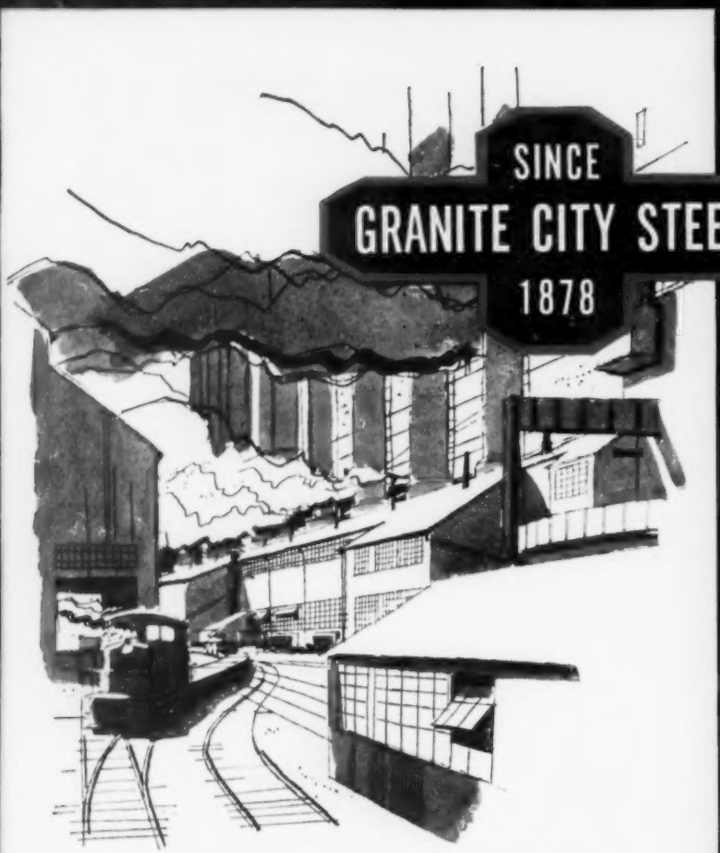
THE magazine *American Automobile* says that growing congestion traffic and the trend to suburban living in the United States may force smaller cars onto the market. Up to the present, they say, U. S. manufacturers have not produced small cars because nobody wants them.

We think there is a definite market for smaller domestic cars of good quality. Certainly, not everyone wants the tinseled, misshapen monsters that Detroit is now pushing on us.

It is reported that the 1956 sale of Volkswagens was 50,000, and a seven-month waiting period exists for one model. Year-old models sell at higher prices than new ones. Personally, we think Volkswagens are too small but please let us have something less than seven feet wide and twenty feet long—and without all the geegaws.

▲

WILLIAM F. VOSMER, who recently retired from Republic Steel Corp., says that a half-century of progress has changed steel but not the way to sell it. His advice: "The best advice for a salesman is the same today as it was in 1903. Get off the seat of your trousers and get out and see your customers. The telephone can never substitute for that face-to-face contact."



GRANITE CITY STEEL COMPANY...

"Keeps Rollin' Along"

And Allis-Chalmers steel mill equipment is helping in a new expansion program designed to increase steel production in mid-America

ALONG the banks of the mighty Mississippi, near the geographical center of mid-America, new steel-making facilities are being planned. Granite City Steel Company is planning another major expansion program which will raise their ingot production 30% by early 1958.

Just two years ago, Granite City Steel completed an $89,000,000 expansion. It was the culmination of a 7-year program, in which Allis-Chalmers supplied all major electrical requirements, bringing this midwestern plant up to maximum efficiency.

In this new modernization, Allis-Chalmers steel mill equipment will again play an important role. So far, Granite City has called on Allis-Chalmers for all the necessary electrical equipment needed to revamp their cold-strip mill, and the single-stand temper mill, plus other auxiliary machines.

Allis-Chalmers specializes in mill modernization and expansion. For specific information on drives, control and other electrical equipment for steel mills, contact your A-C representative, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Other Allis-Chalmers Products for the Steel Industry

Centrifugal Blowers • Axial Blowers • Arc-Furnace Transformers • Mercury-Arc Rectifiers • Rotary Compressors
Unit Substations • Switchgear • Circuit Breakers • Voltage Regulators • Power Generation Equipment

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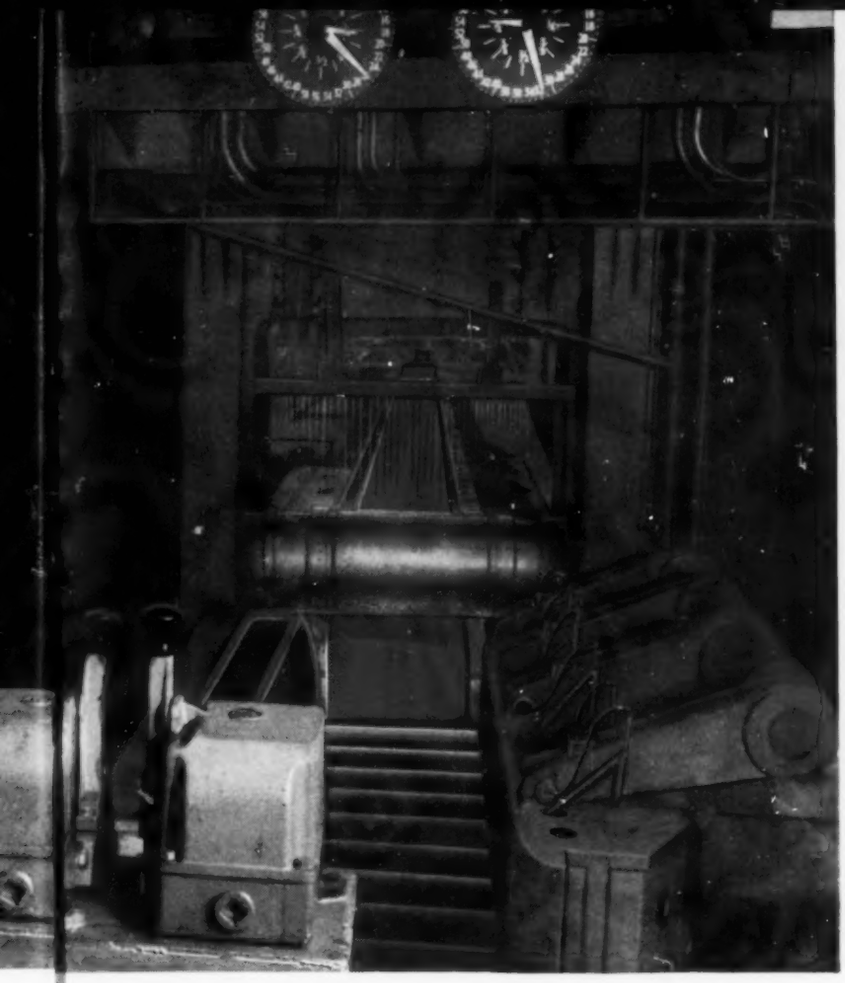
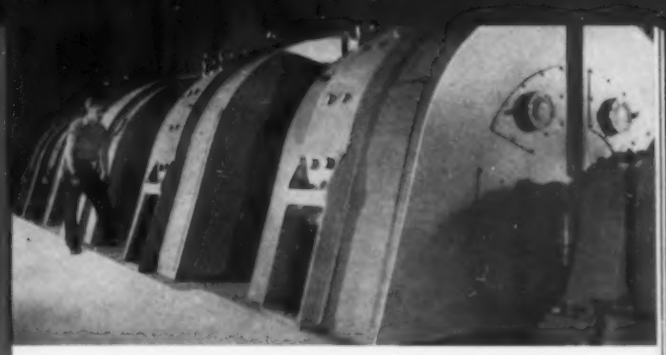
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-5178

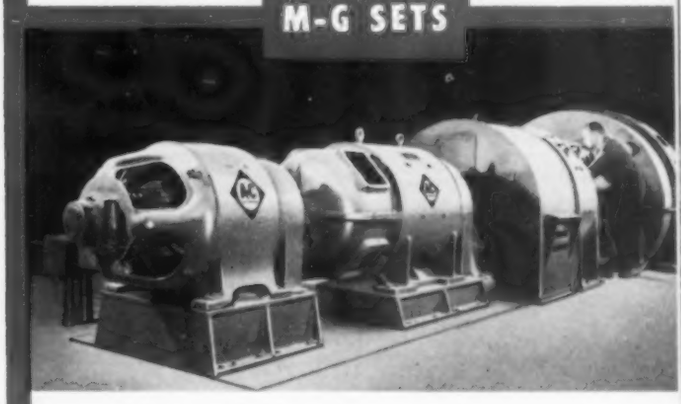
Regulex is an Allis-Chalmers trademark.





M-g sets supporting cold-strip mill motors. These units are rated at 7750 kw, 514 rpm. Furnished by Allis-Chalmers in 1946, they will be supplemented by new units.

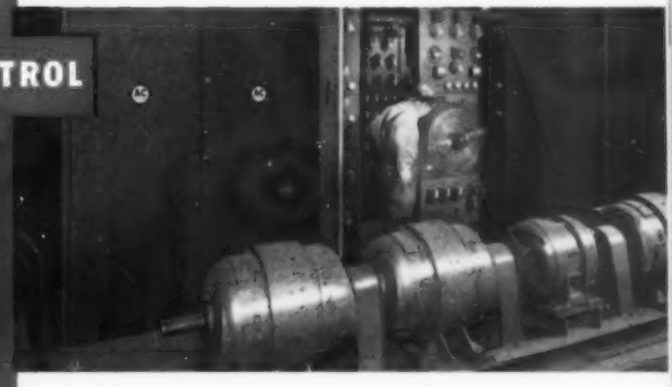
M-G SETS



On the 56-inch temper mill, this 4-machine m-g set supporting the skin pass mill motors will be revamped. Two new 225-kw dc drag generator units will be furnished by Allis-Chalmers for this mill.

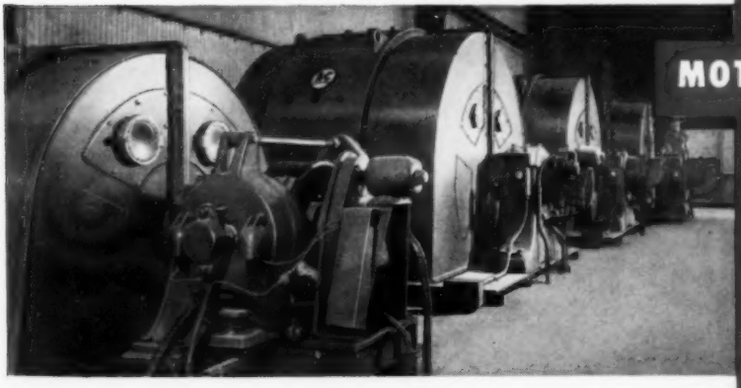
CONTROL

This variable voltage control board is used on the 56-inch tandem cold reduction mill. New control equipment is being furnished by Allis-Chalmers for new mill expansion at this midwestern steel plant.

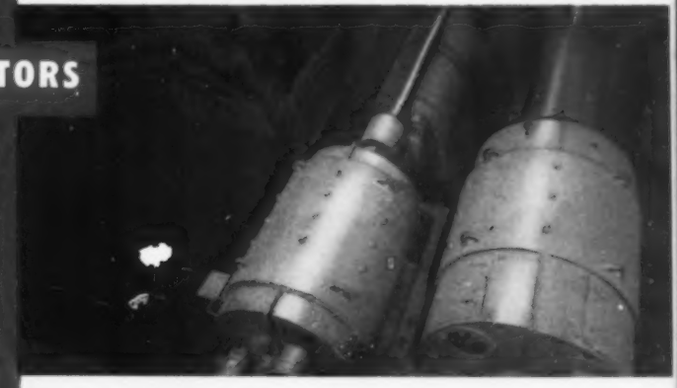


Regulex control and totally enclosed control board were furnished by Allis-Chalmers in 1948 for the 48-inch temper mill at Granite City Steel Co. Additional control is being furnished for the 56-inch temper mill.

MOTORS



Motor room view at this plant shows Allis-Chalmers units driving delivery reel and main stands. Allis-Chalmers motors furnish drive power throughout the plant. New motors, ranging in size from 25 to 5000 hp, are being installed.



Allis-Chalmers motors shown driving the temper mill include main roll drive, delivery tension, and delivery reel drive. Allis-Chalmers furnished original motors for both temper mills, as well as new motors for increasing capacity.

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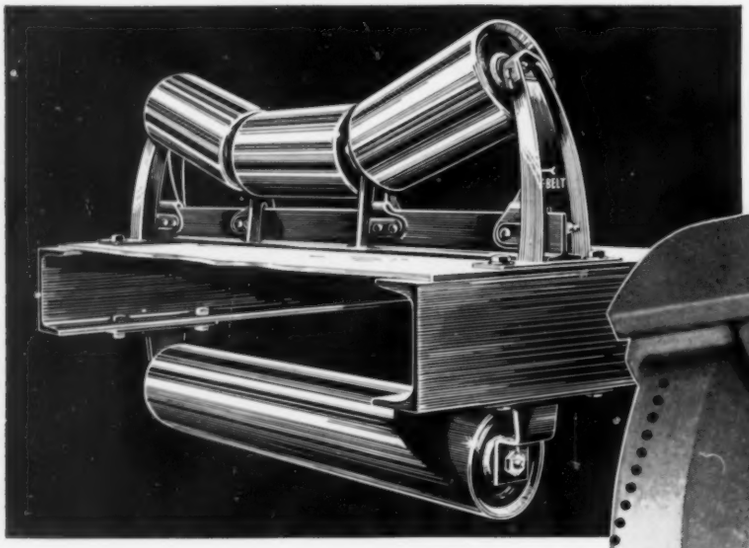
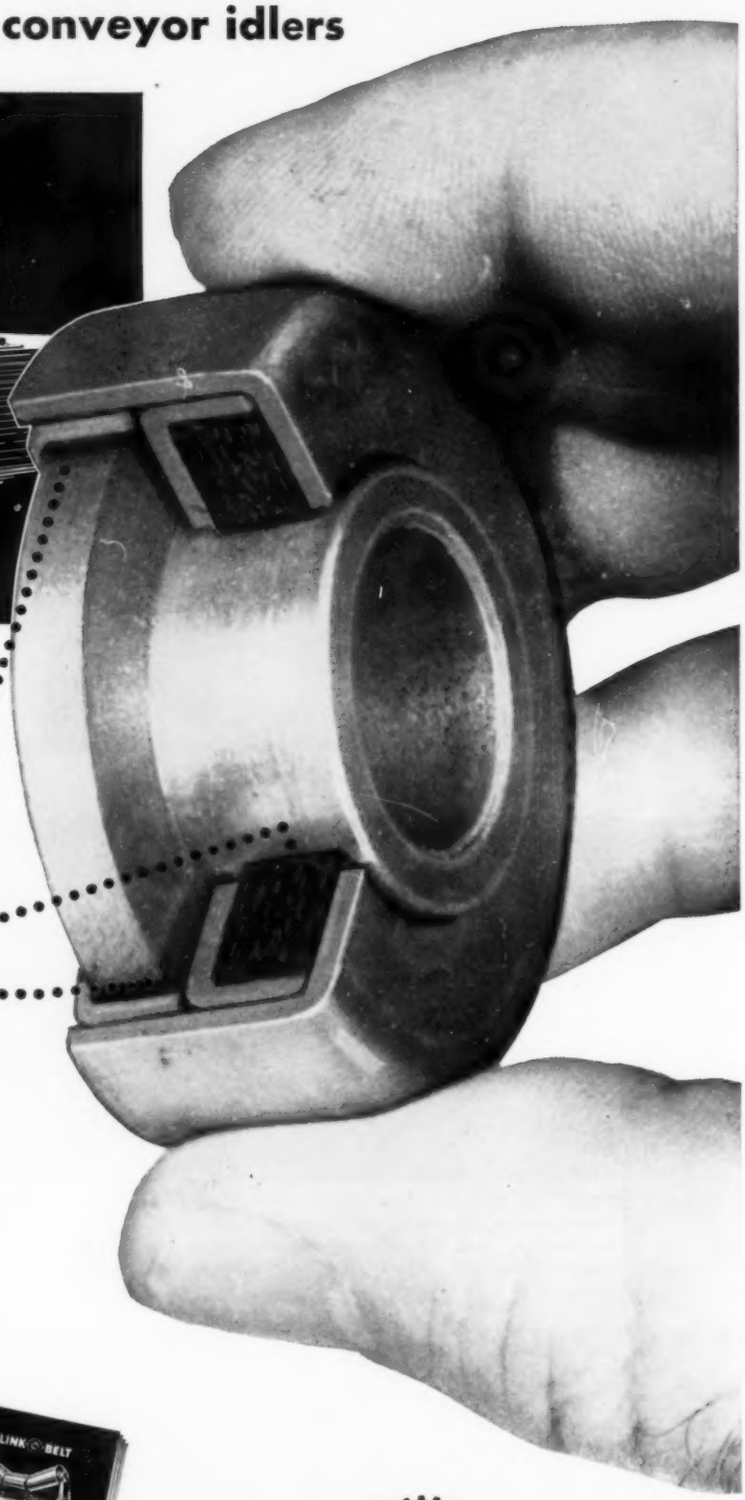
...yours in LINK-BELT belt conveyor idlers





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- **Contact seal**
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This compact, one-piece cartridge — a Link-Belt exclusive — is industry's simplest and most effective seal. Its three-way protection holds grease in, keeps dirt out for long bearing life. What's more, inspection and maintenance are simplified. No springs, clips and other small parts to lose . . . no metal-to-metal contact.

This superior seal is one of many long-life Link-Belt features. Others:

- *husky, high quality bearings*
- *precision-machined concentric rolls*
- *strong, rigid frames*
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These features are standard in most Link-Belt idlers . . . industry's only comprehensive line. For details on specific series, call your Link-Belt office or authorized stock-carrying distributor. Or write for Book 2416.

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LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14.2[98]

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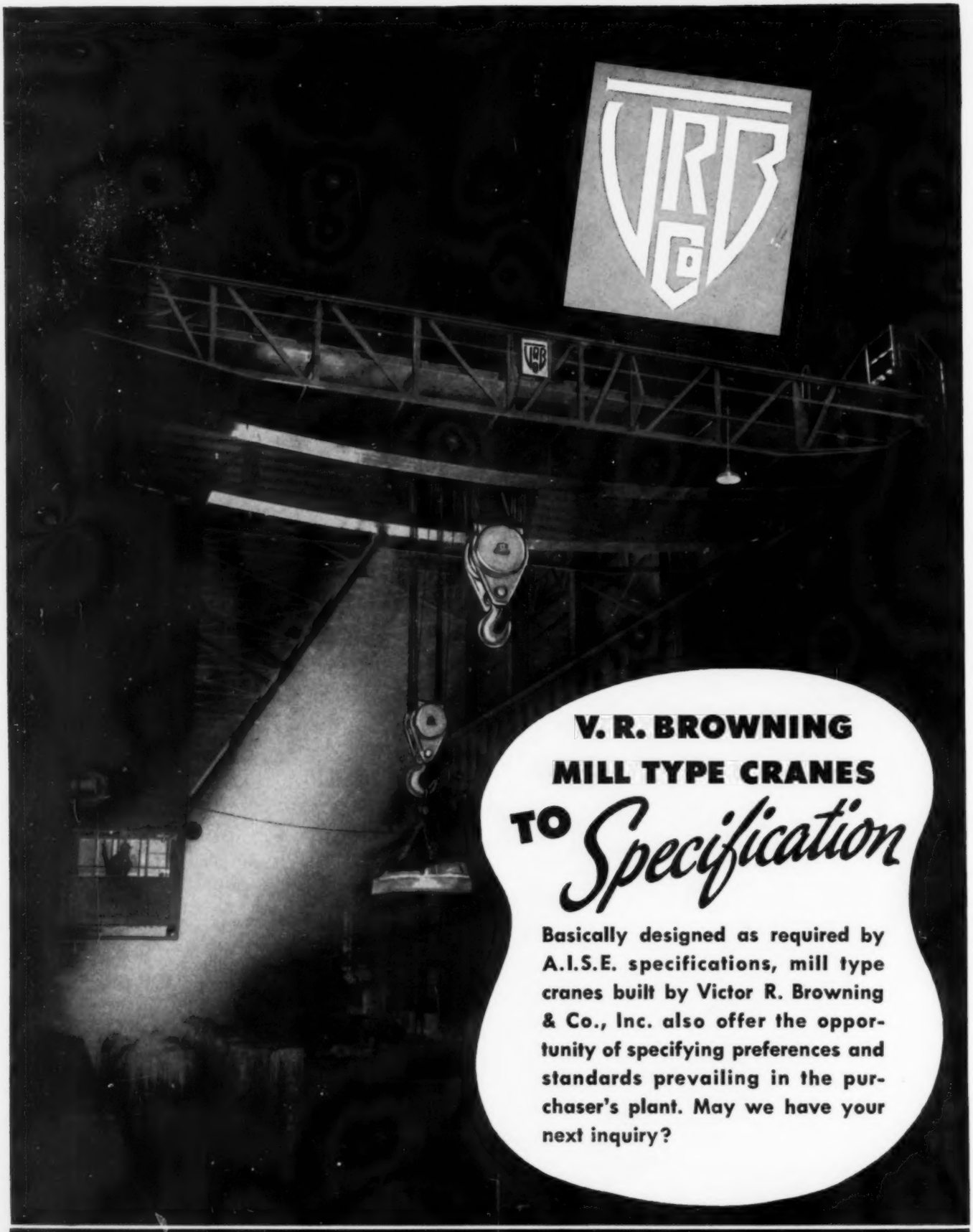
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Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

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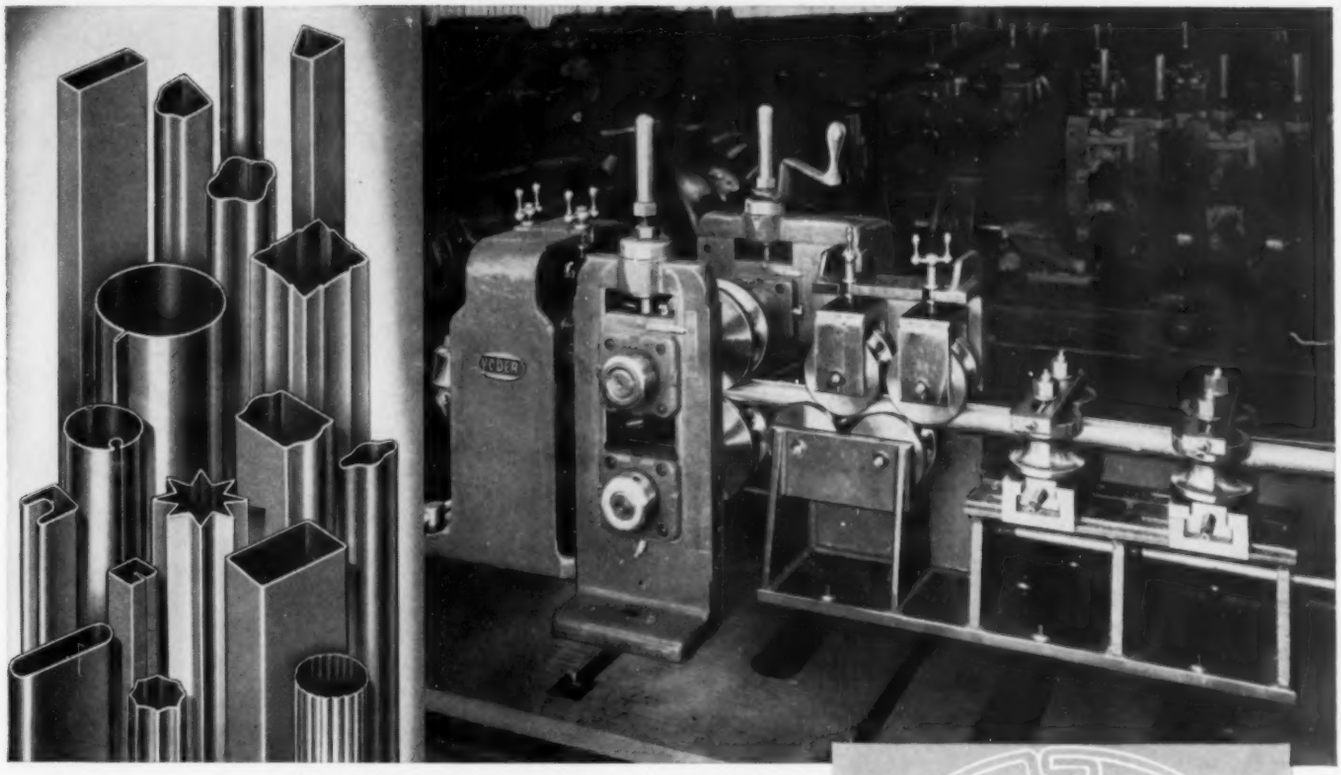

Lock-Seaming attachment at exit end of forming machine.

COLD ROLL FORMING TUBULAR SHAPES

Among the wide variety of things you can make on a Yoder Cold Roll Forming machine are round, square, oval, rectangular and other tubular shapes, such as illustrated at left above. The seams may be open, lapped, butted, dovetailed, interlocking, etc.—as indicated in Figures 1 to 6 at the right.

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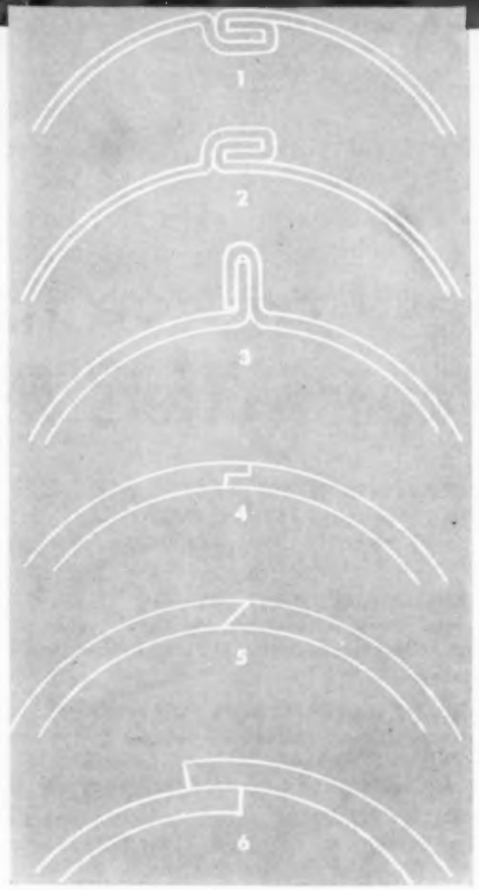
The Yoder book on Cold Roll Forming is a complete, illustrated text on the art and the equipment needed for performing a variety of operations which can be combined with cold roll forming, at little or no extra labor cost. A copy is yours for the asking.



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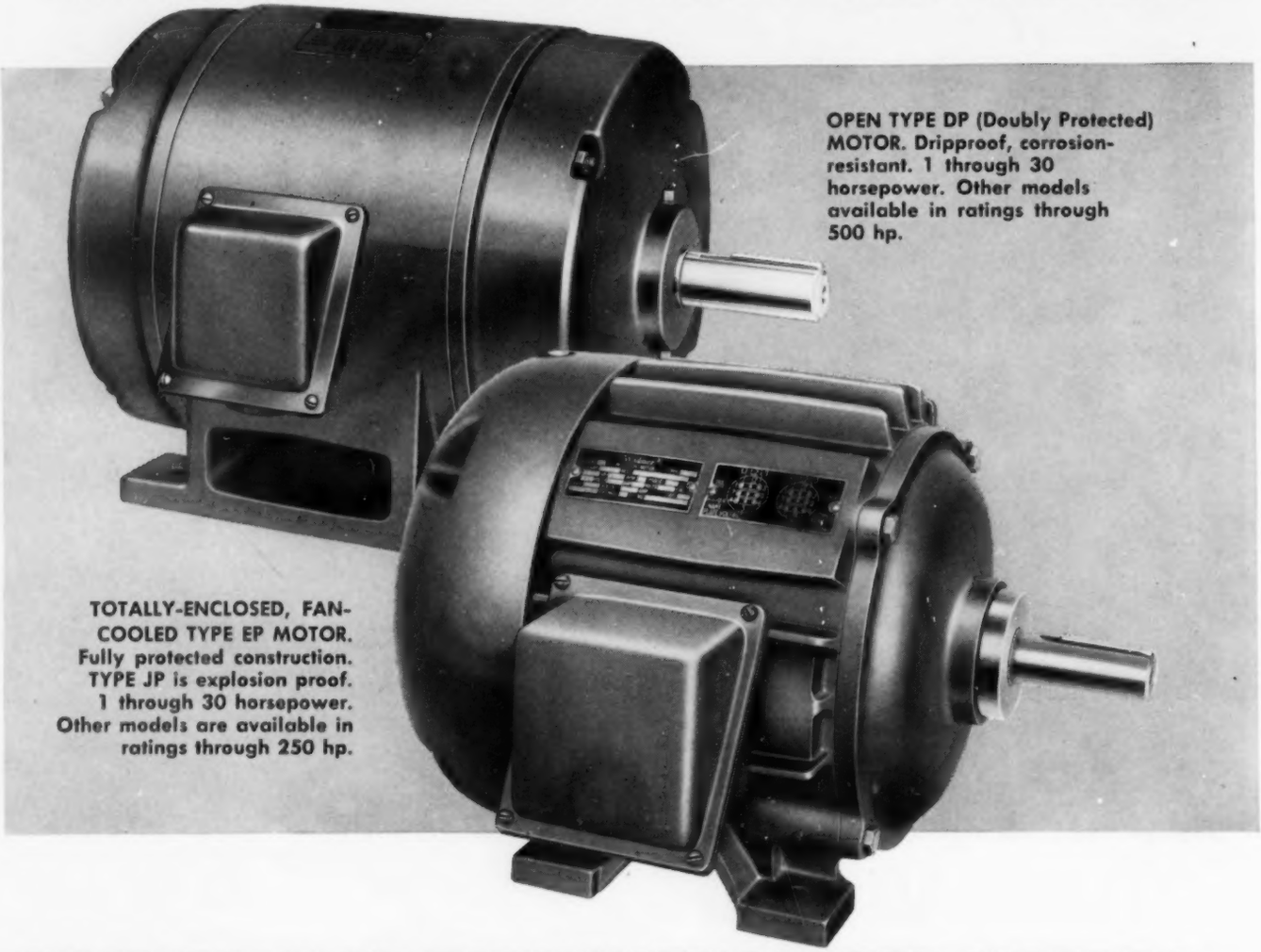

OPEN TYPE DP (Doubly Protected) MOTOR. Dripproof, corrosion-resistant. 1 through 30 horsepower. Other models available in ratings through 500 hp.

TOTALLY-ENCLOSED, FAN-COOLED TYPE EP MOTOR. Fully protected construction. TYPE JP is explosion proof. 1 through 30 horsepower. Other models are available in ratings through 250 hp.

OPEN TYPE OR TOTALLY ENCLOSED MOTORS...

Wagner offers MORE for your motor dollar!

- **MORE POWER IN LESS SPACE** . . . These motors are built in NEMA frame sizes 182 through 326 U. They pack more power into less space for easier handling and stocking—require less space for installations.
- **CORROSION-RESISTANT FRAMES** . . . Both types are built with rugged, corrosion-resistant cast iron frames. Motor feet are cast as an integral part of the frame for maximum strength and rigidity.
- **THE TYPE OF PROTECTION YOU NEED** . . . Type DP motors have completely dripproof—virtually splash-proof enclosures; while type EP is totally enclosed, fan-cooled for complete protection; and type JP adds explosion proof features.
- **COOLER OPERATION** . . . Special baffles direct a cooling flow of air through the DP motor. Types EP and JP are fan-cooled and have ribbed frames to increase the surface area for more efficient cooling.
- **LONGER BEARING LIFE** . . . These motors can be re-greased when desired to prolong bearing life. Fresh grease can be added—old grease removed through openings provided in the bearing housing.
- **WAGNER DEPENDABILITY** . . . These two motors have the same high Wagner quality, will give the same long life performance, that have made Wagner Motors a *known* value for sixty-five years.
- Let a Wagner field engineer, expert on motor applications, show you how these motors can be applied to your needs. Call the nearest of our 32 branch offices, or write us. Bulletins MU-202 and MU-203 give complete information on these Wagner Motors. Write for your file copies today.

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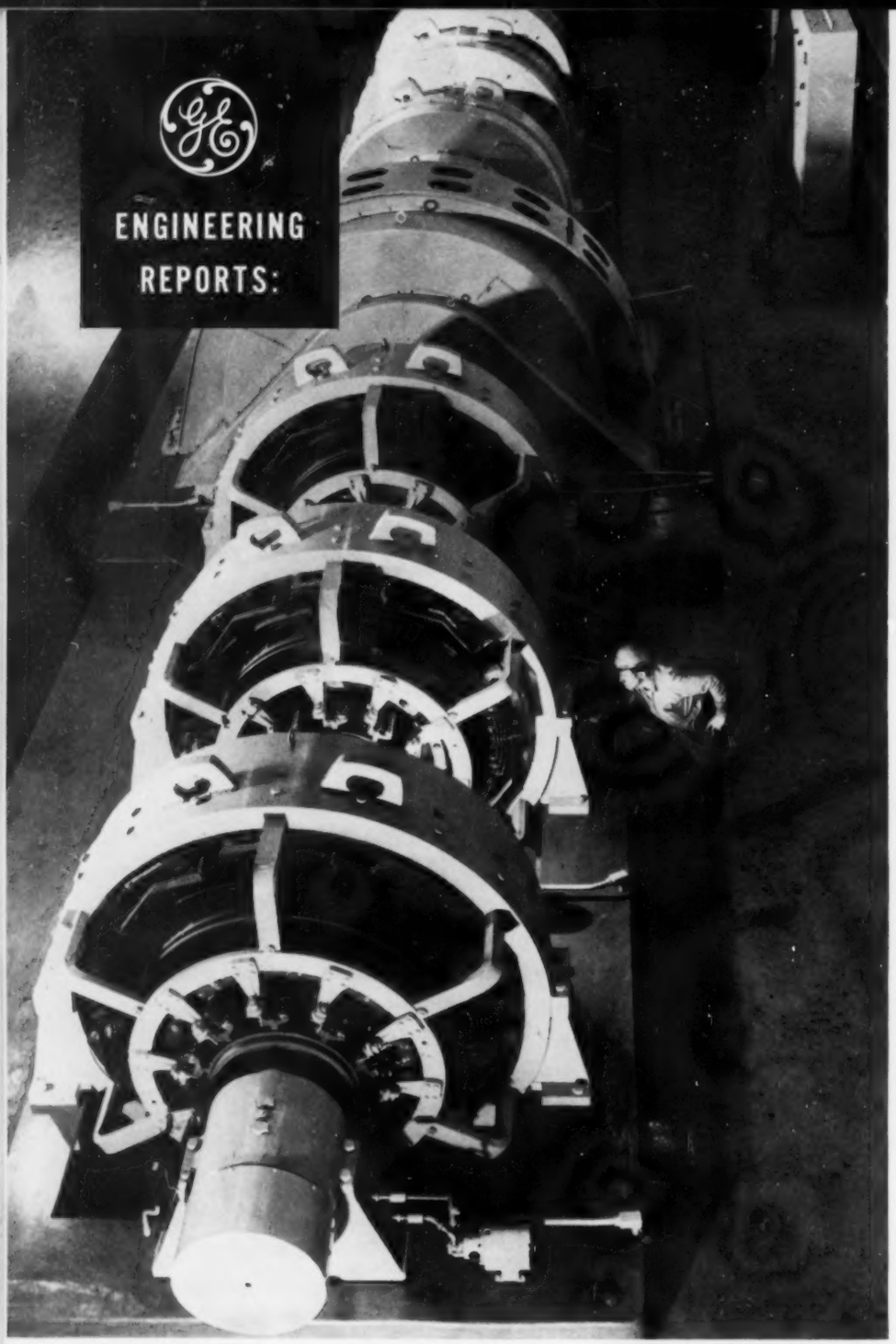
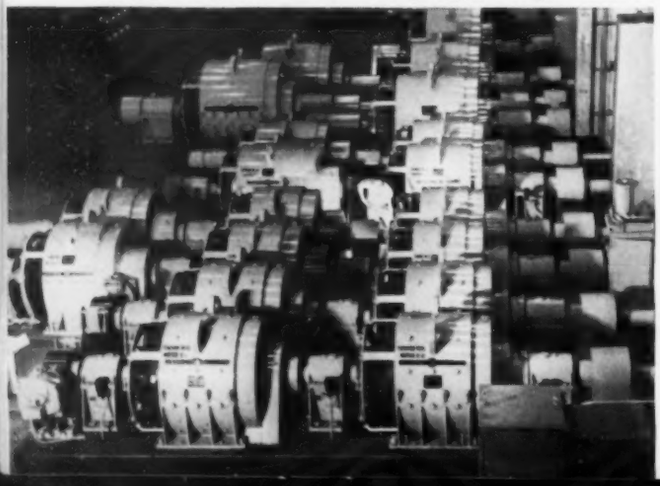


SUPPLYING POWER for stands 3 and 5, and tension reel, one of two huge G-E motor-generator sets has 15,000-hp synchronous motor and six duplicate 2000-kw generators.

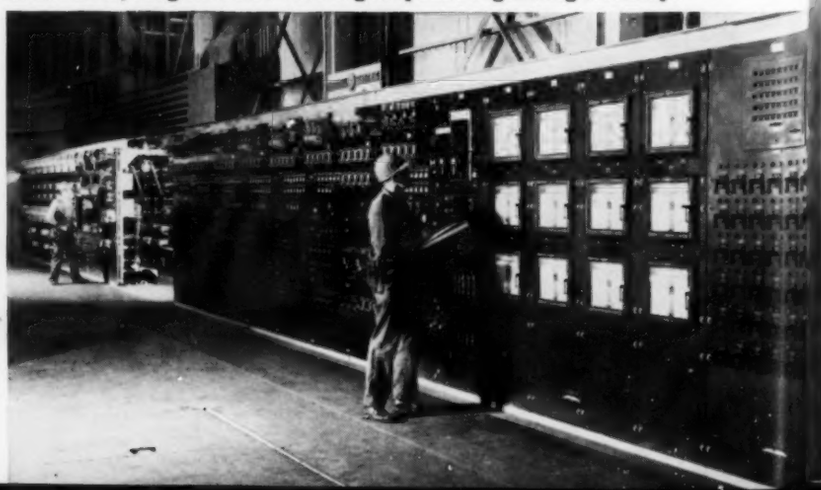
AUTOMATIC THICKNESS CONTROL system includes stand 1 X-ray indicator (left), X-ray gage (center). Operator's control cabinet is shown at right.

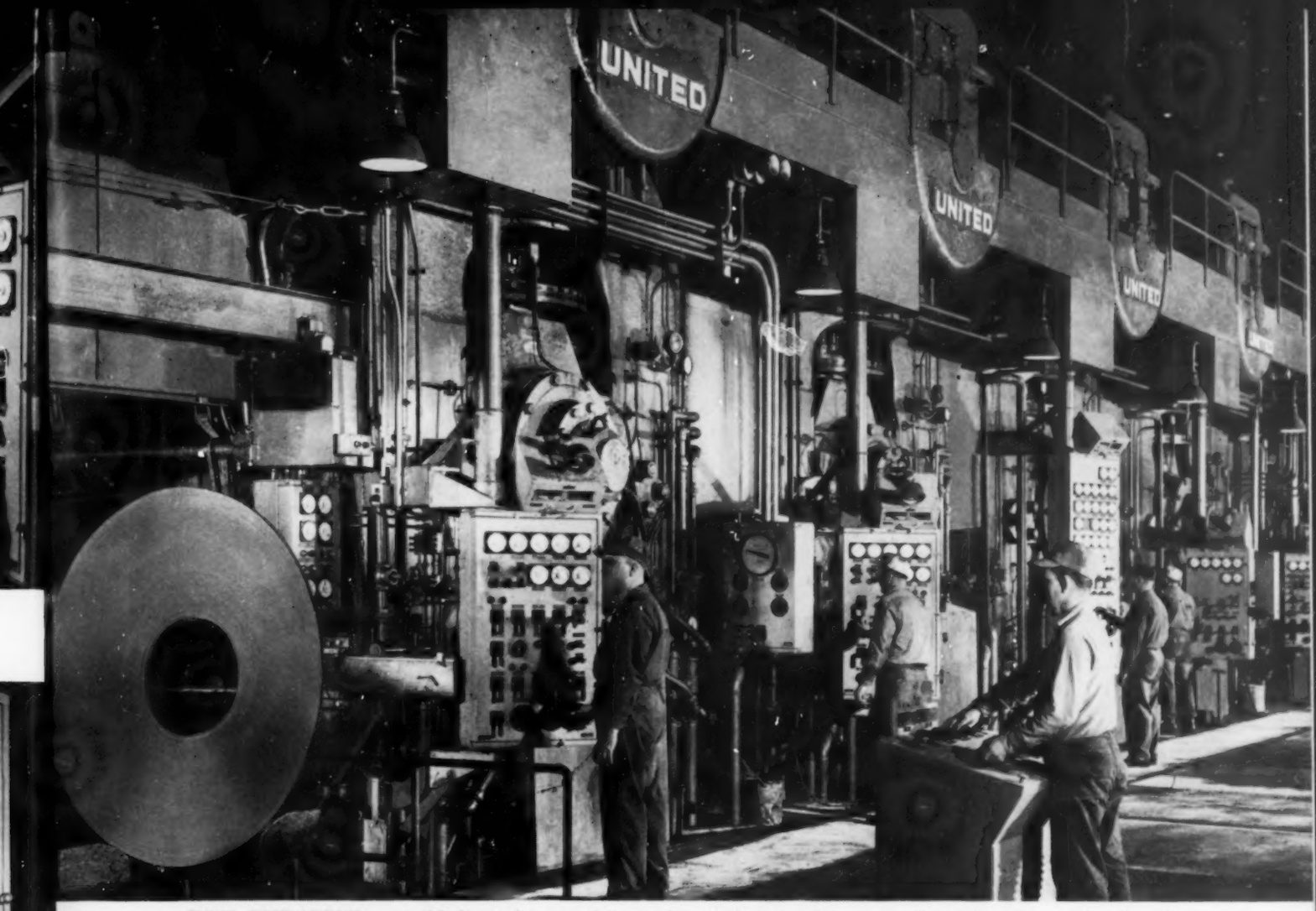
CLOSER TOLERANCES at higher speeds are obtained with thickness control system. Gage control panel shown above.

FAST acceleration, balanced speed regulation are obtained using specially designed, low inertia, d-c drive motors, designed to fit mill's rigid space requirements.



ACCURATE system control is provided by main-drive d-c control equipment. Designed by G.E. for cold mills, panel includes memory fault finder, magnetic and rotating amplifier regulating circuitry.





CHIEF OPERATOR'S control is located at stand 3, speed control at stand 5, on new 5-stand tandem cold strip mill.

At Weirton Steel: 28,000 hp Drives World's Most Powerful Cold Strip Mill

General Electric X-ray controlled cold mill drive system is world's fastest

National Steel Corporation's Division, Weirton Steel Company, Weirton, West Virginia, recently started up their new 5-stand tandem cold mill with a General Electric d-c drive system containing the world's greatest concentration of cold mill drive horsepower. With the new General Electric automatic X-ray gage control system, Weirton Steel Company's cold mill is another significant example of automatic production providing higher quality steel, with closer tolerances, at higher rolling speeds.

THE AUTOMATIC GAGE control system, one of the newest General Electric developments for the steel industry, has two basic elements: (1) a course regulating system to correct errors by means of the stand 1 screwdown motors, with the X-ray gage measuring stand 1 steel thickness; and (2) a vernier system controlling stand 5 drive motor speed, with the X-ray gage measuring finished strip thickness. Some of the highlights of the drive and control system are shown on these pages.

FROM INITIAL PLANNING, General Electric engineers worked closely with Weirton personnel and the United Engineering and Foundry Co. to help design, install and start up this engineered system that helps Weirton meet increased steel production requirements. Get complete information on the latest General Electric equipment and methods from your Apparatus Sales Representative at the nearest General Electric Apparatus Sales Office, early in your planning. 659-113

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(Division of National Steel Corporation)
ECORSE, DETROIT 29, MICHIGAN.

. . . they're "FACTORY MOLDED" as one-piece Neoprene/rubber units!

Can you think of a more demanding environment for electrical connectors . . . than the water-soaked, run-out motor installation pictured above? If you can, odds favor a bet that JOY connectors are "at work" there, too! For in all those qualities that add up to a long life of dependable, maintenance-free performance, JOY electrical connectors excel.

Factory molded as one-piece Neoprene jacketed units, *that resist impact damage like a rubber ball, and are practically immune to the aging effects of oils, acids, alkalines and sunlight . . .* JOY electrical connectors are rapidly becoming Industry's favorites for portable power and control circuits. When connected, close-fitting face sections provide "cork-like" seals around engaged contacts, protecting them from moisture, metallic dust and other airborne particles that are so damaging to an electrical connector's performance.

Want specific information on JOY connectors for your electrical circuits? Describe your needs and we'll mail it promptly! You'll be glad to have this information handy, next time you need good electrical connectors.

use them with . . .

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- MOTOR CONTROL CIRCUITS
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- POWER LINES TO LADLES

YOURS . . . ASK FOR IT!

BULLETIN B41 — An attractive, three-color bulletin that illustrates and describes JOY electrical connectors for Steel Mills, Foundries, and other heavy industrial needs.

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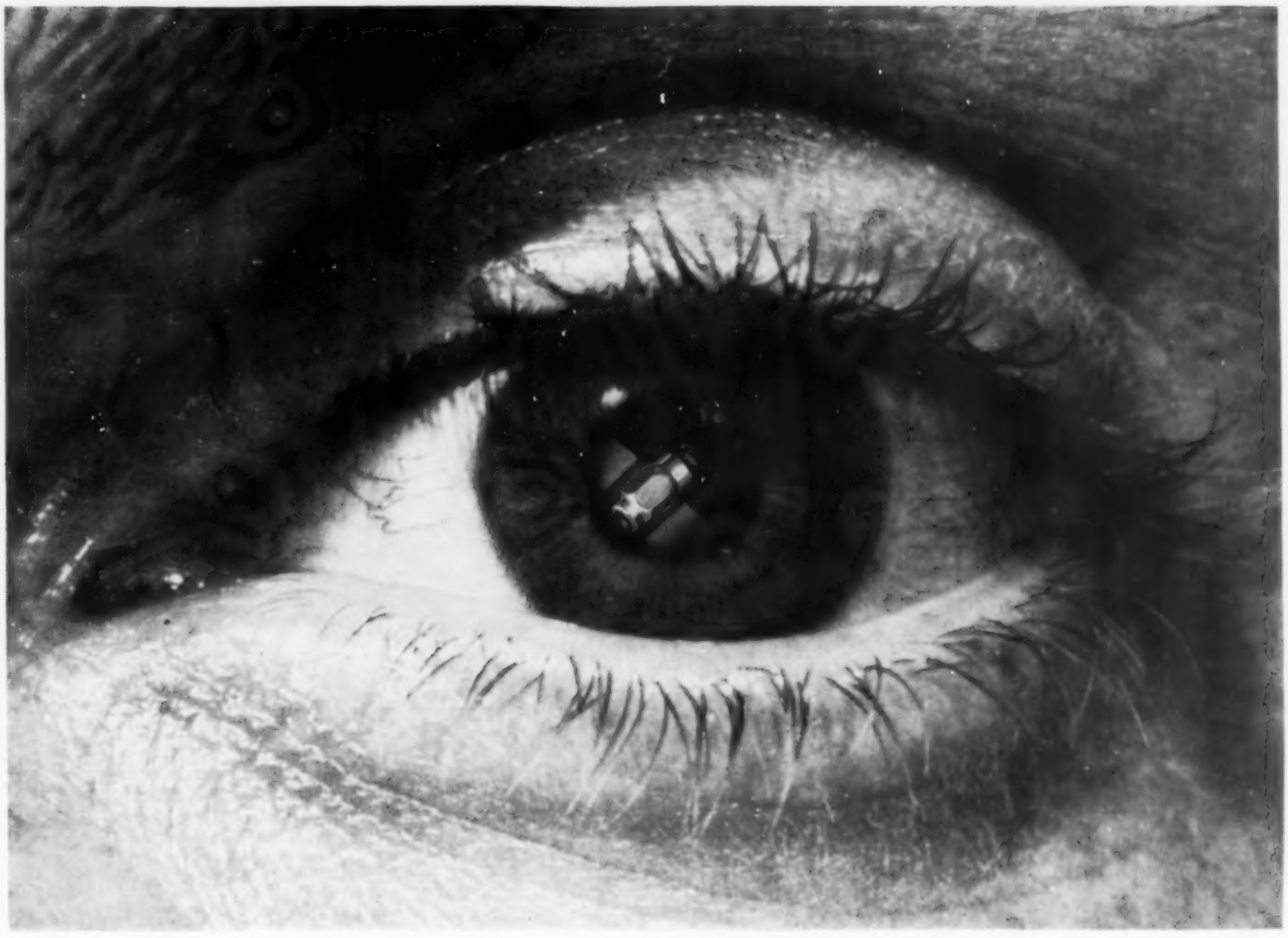


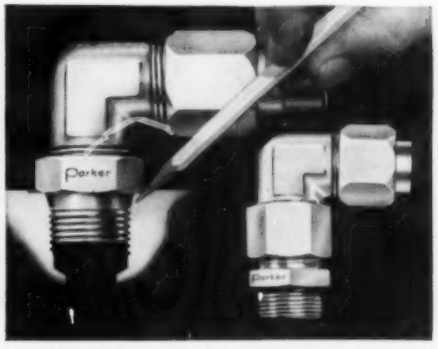
Be sure to see Parker for both tube and hose fittings!

Here, from one convenient source, you can get the most advanced hydraulic fittings available . . . both tube *and* hose. For example, new Parker *no-skive* Hoze-lok fittings require no stripping of rubber-covered hydraulic hose. They're faster, easier to use and *re-usable.*

Also, new Parker *straight-thread* tube fittings solve high-pressure hydraulic leakage problems resulting from tapered pipe threads. *Straight* threads are available on Triple-lok (the industrial standard flare tube fitting) and on Ferulok (flareless fitting for heavy steel tubing).

Parker
Hydraulic and fluid system components

***No-skive* Hoze-lok fittings** need no stripping of hose covers. Only two simple steps complete the make-up. Re-usable.



Straight-thread tube fittings provide leakproof, trouble-free connections. No overtightening. O-ring makes the seal.

TUBE & HOSE FITTINGS DIVISION
Section 422-L
The Parker Appliance Co.
17325 Euclid Ave., Cleveland 12, Ohio

☐ Please send *no-skive* Hoze-lok Bulletin No. 4402
☐ Straight-thread fittings Catalog No. 4301

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COMPANY_____

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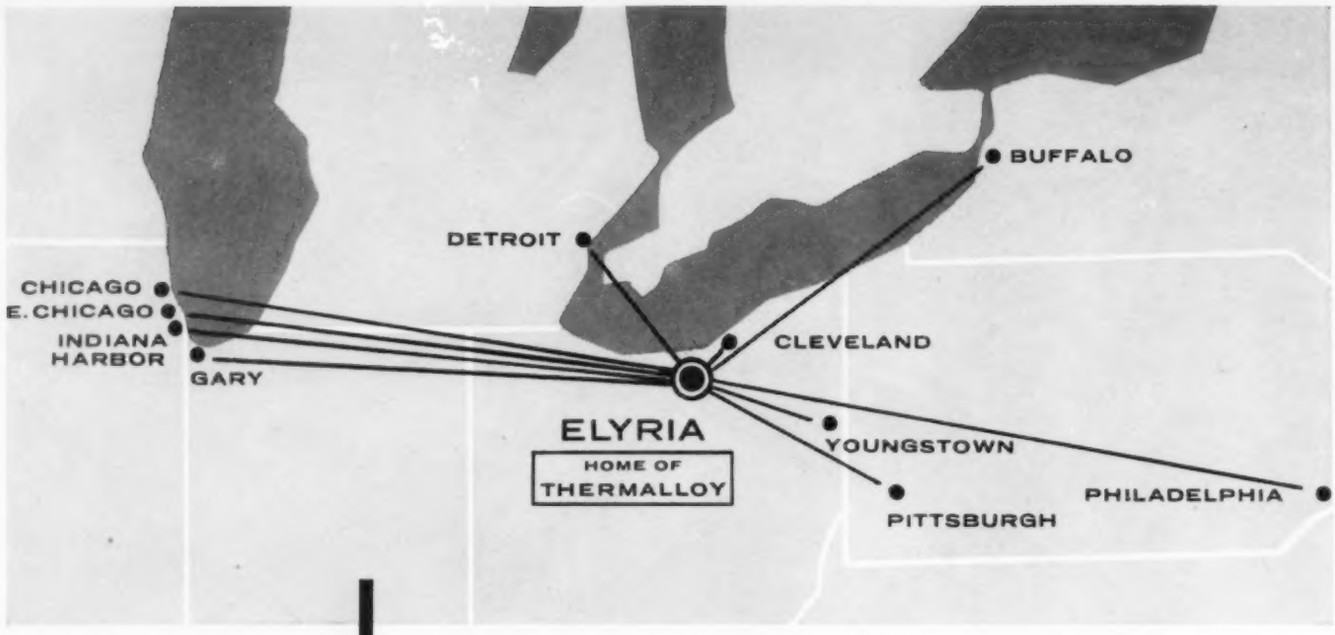


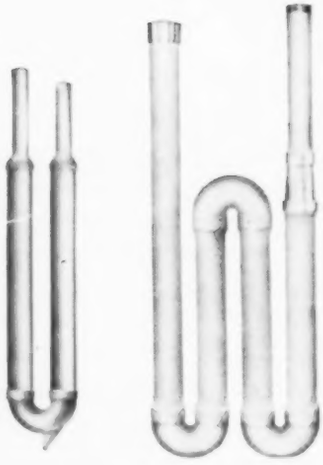
EVER BEEN IN ELYRIA, OHIO?

Perhaps you haven't. But the map shows how centrally located it is to major steel-producing centers . . . an advantage our steel mill customers seem to like.

If you *are* here sometime, we'd like to show you through our Electro-Alloys plant—one of the most modern alloy foundries in the country. You'll see a lot of steel mill parts being cast, too—because our steel-industry customers have found that *THERMALLOY** heat-resistant castings give long-life economy in many tough applications.

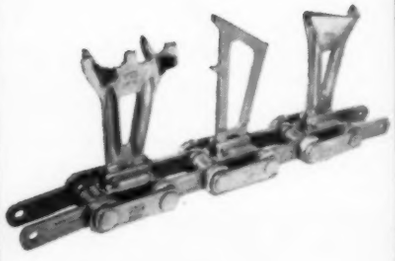
If you can't visit us, call our nearest sales representative. He'll put our expanded facilities to work for you on any high-heat-resistant casting requirement you may have, such as the parts shown below.

*Reg. U. S. Pat. Off.



Thermalloy Radiant Tubes Centrifugally cast, X-ray controlled, pressure-tested.

Thermalloy Furnace Rolls ...for roller-bottom furnaces.



Thermalloy Carrier Blades and Chain ...Three types of blades, mounted on *Thermalloy* conveyor chain.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION Elyria, Ohio

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Patent Reviews

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents . . . . patents reviewed cover period August 7, 1956 through August 28, 1956 . . .

OPEN HEARTH CHARGING CONTAINER

▲ U. S. 2,757,925, issued Aug. 7, 1956, to Charles E. Carr and assigned to National Steel Corp., describes an open hearth charging car.

As shown in Figure 1, the charging car 18 has wheels 28 mounted on rails 17 for moving from one furnace to another. In operation, the charging machine and the charging car are moved into alinement with the furnace which is to be charged. Then the operator, while stationed at the customary set of controls on the charging machine, moves the head 24 of the peel 23 against the wall 40 of the container 18. As shown in Figure 2, the head of the peel fits between members 45 and 46, engage the head of the peel with the wall 40. After the door or doors 12 have been raised to uncover the doorway 11, the bridging sidewall 34 (Figure 2) is swung down into position to bridge the space between the furnace and the car, and then the movable sidewall 40 is moved across the car to push the charge into the furnace. The operator then retracts the peel to move the sidewall back, and after the peel has been released by lifting it, and the sidewall 34 has been swung back up, the car is moved along the track 17 out of the way.

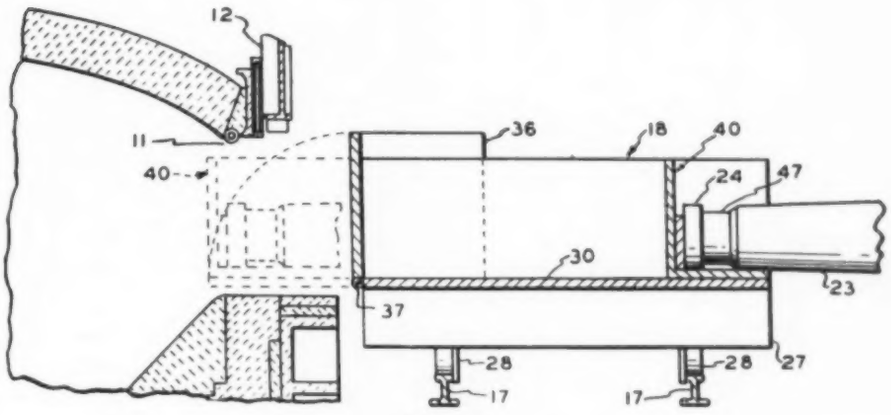


Figure 1

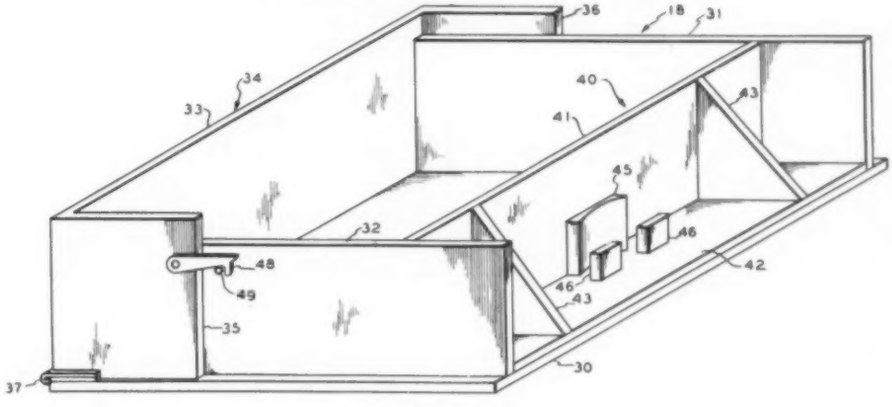


Figure 2

TREATMENT OF COKE OVEN EFFLUENT

▲ U. S. 2,758,968, issued Aug. 14, 1956, to Thomas H. Williams and George S. Solt, assigned to The Permutit Co. Ltd. et al., describes a process for treating coke oven effluent to remove phenol and tar acids by activated carbon.

An increase in the life of the activated carbon is obtained by passing the liquor through a bed of an alkali-activated anion-exchange material having large pores, before passing the liquor through the bed of activated carbon. A large part of the coloring matter is removed in the ion-exchange bed.

In addition to increasing the life of the activated carbon, the condition of the final liquor is also improved.

GAS TURBINE PLANT FOR USE IN METALLURGICAL PLANTS

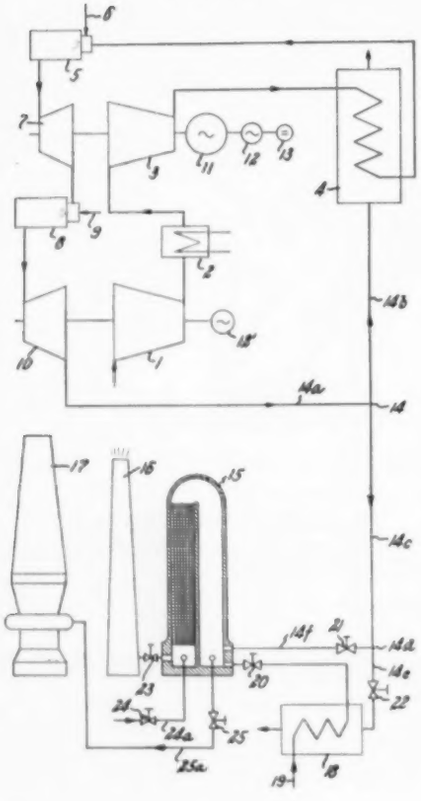
▲ U. S. 2,758,827, issued Aug. 14, 1956, to Hans Pfenninger, and as-

signed to Aktiengesellschaft Brown, describes a combustion gas turbine plant and a means for utilizing its discharge gases as a source of heat for the stoves of a blast furnace plant.

In Figure 3, a two-stage gas compressor is shown. The low pressure stage compressor 1 is driven by the turbine 10. Compressed air leaving compressor 1 passes through an interstage cooler 2 and then to the high pressure stage compressor 3, driven by turbine 7. Compressed air from compressor 3 passes through an air preheater 4 heated by a portion of the exhaust gases from low pressure turbine 10, and is delivered to a high pressure combustion chamber 5, into which fuel is admitted at 6. The resulting hot mixture of air and combustion gases passes from chamber 5 through turbine 7 to drive it and its compressor 3 and an electric generator 11. (On the same shaft are the motor 12 for starting the turbine and the exciter 13 for supplying field current to generator 11.) The gases pass from turbine 7 to an interstage chamber 8 having a fuel inlet 9 for a second heating and are then passed into turbine 10, driving it, compressor 1, and its starting motor 12.

After leaving turbine 10, the combustion gases still possess considerable heat, and are passed partly to the air preheater 4, and partly to the blast stove 15. A portion of the exhaust gases from the combustion turbine is used in preheating blast furnace gas 19 in preheater 18; another portion directly enters the stove to supply a part of the combustion air requirement.

Figure 3



The principal advantages of this system are that neither the blast furnace plant nor the gas turbine plant is modified from its regular design, and that each can be operated independently of the other.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,757,505–6	8/7/56	Preforming head for wire-stranding machine	United States Steel Corp.
2,757,556	8/7/56	Gear drive for rolling mill	Fredrich Kocks G.m.b.H.
2,757,623	8/7/56	Composite furnace roof construction	General Refractories Co.
2,757,731	8/7/56	Bloom and slab shears	Schloemann Aktiengesellschaft
2,757,806	8/7/56	Furnace charging apparatus	Republic Steel Corp.
2,757,919	8/7/56	Forge furnace	Delaware Tool Steel Corp.
2,758,019	8/7/56	Separation of iron from titaniferous iron ores	National Lead Co.
2,758,025	8/7/56	High temperature stainless steel	Armco Steel Corp.
2,758,919	8/14/56	Pelletizing iron ore	Erie Mining Co.
2,758,950	8/14/56	Producing steel by electroforming and carburization	U.S. Atomic Energy Comm.
2,759,301	8/21/56	Apparatus for surface grinding metal strip	Crucible Steel Co. of America
2,759,723	8/21/56	Compress laminated refractory block for metallurgical furnaces	Giovanni Crespi
2,759,808	8/21/56	Production of iron powder	Alan Wood Steel Co.
2,759,810	8/21/56	Method of making articles of sintered iron	Max Koehler
2,759,863	8/21/56	Apparatus for carburizing	Metallurgical Processes Co.
2,759,884	8/21/56	Coke oven doors	John M. Gillott
2,759,885	8/21/56	Gas take-off system of coke oven battery	Allied Chemical & Dye Corp.
2,760,544	8/28/56	Strip handling apparatus	United States Steel Corp.
2,760,546	8/28/56	Apparatus for making a metallic belt	United States Steel Corp.
2,760,771	8/28/56	Foundry cupola with separate fuel supply	Walter J. Knappe
2,760,856	8/28/56	Production of low sulphur blast furnace iron	United States Steel Corp.
2,760,923	8/28/56	Apparatus for reverse current protection of anodes in electropickling	Republic Steel Corp.
2,760,929	8/28/56	Electroplating apparatus	Republic Steel Corp.
2,761,003	8/28/56	Apparatus for removing gases from an arc furnace	Research Corp.
2,761,014	8/28/56	Multiple-station selective communication system with single amplifier	United States Steel Corp.

DESULPHURIZATION OF MOLTEN IRON

▲ U. S. 2,758,920, issued August 14, 1956, to Lawrence B. Gilcrest, Sr., and Lawrence B. Gilcrest, Jr., describes a method and apparatus for the treatment of molten iron with desulphurizing chemicals such as caustic soda or soda ash in the furnace runners.

The desulphurizing chemical is heated and liquified, then superheated and partially gasified, and is passed in finely divided form into the bottom of the runner, insuring maximum contact between the desulphurizer and the iron. A desulphurizing slag is also maintained on the surface of the molten iron to prevent fuming and to obtain maximum desulphurizing effect.

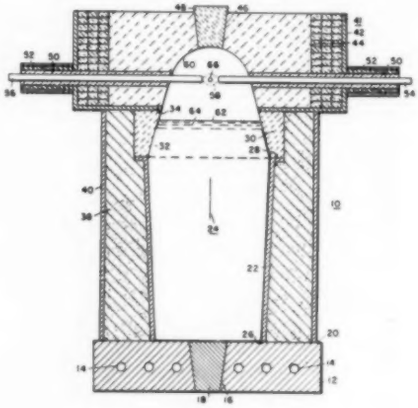
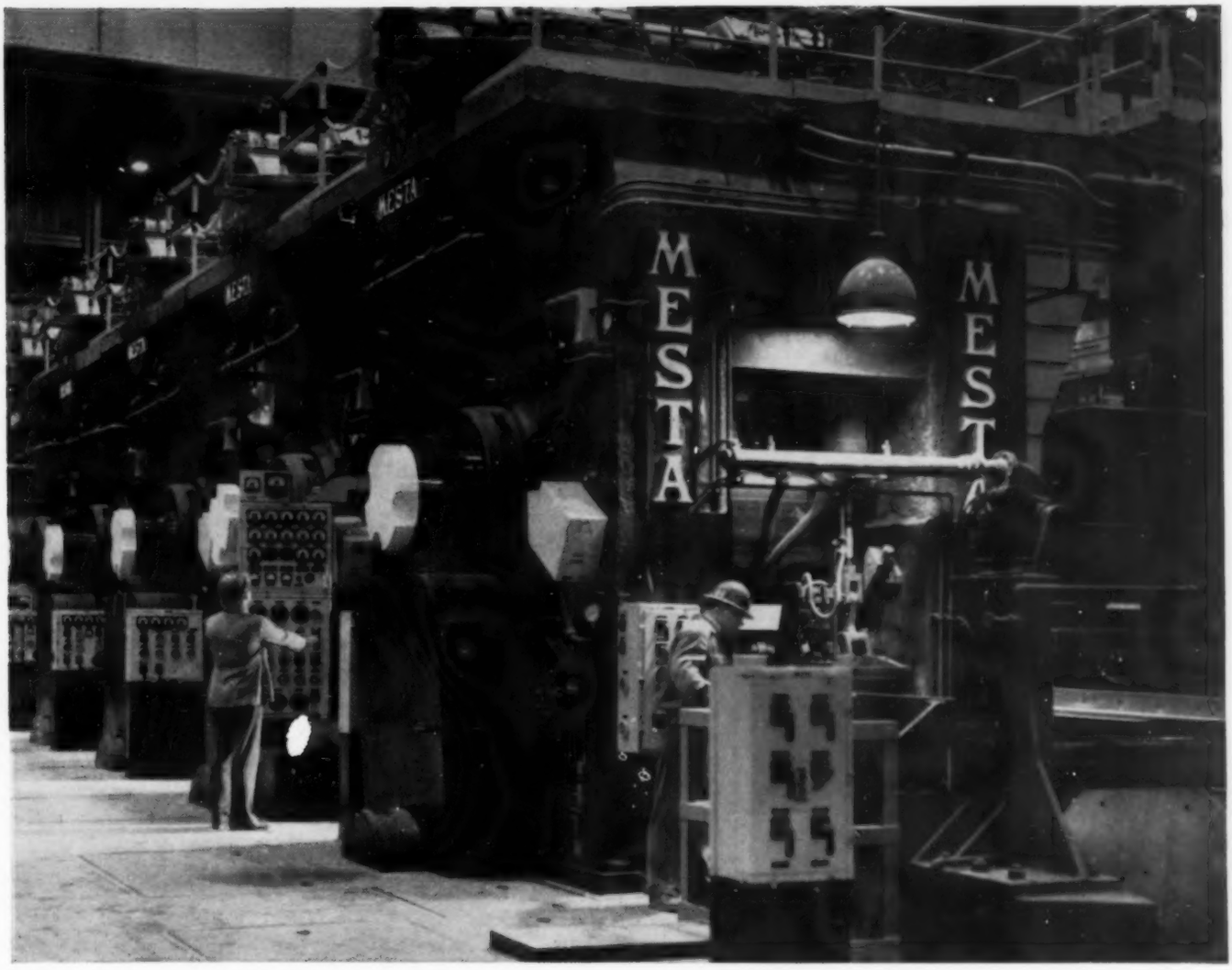


Figure 4

INGOT MOLDS PROVIDED WITH A HOT-TOP

▲ U. S. 2,759,230, issued Aug. 21, 1956 to Robert B. Gordon and Ezekiel F. Losco, assigned to Westinghouse Electric Corp., describes an ingot mold suitable for casting high alloy content ingots, in which the extraction of heat from the bottom of the teemed ingot is so correlated



The back-up roll bearings on this cold reduction mill at U. S. Steel's Fairless Works are protected by Gulf I-C Oil—the oil that maintains its excellent lubricating qualities in rugged service.

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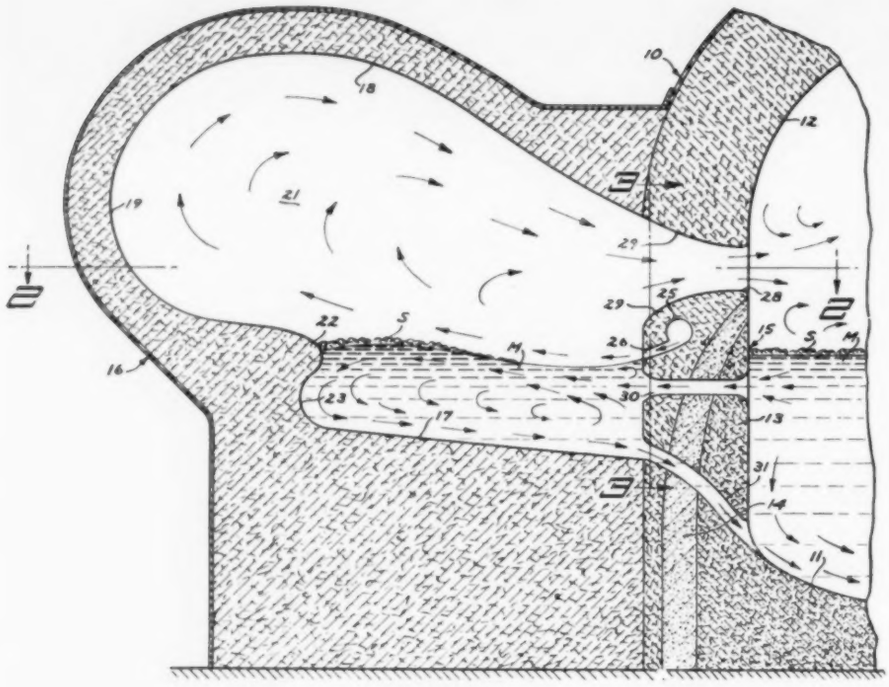


Figure 5

to the extraction of heat from the sides of the mold, that horizontal columnar grains do not extend to the axis of the mold, so that a high proportion of recoverable sound metal is consistently obtained.

Figure 4 shows an ingot mold 10 with a stool 12 having a thermal conductivity of 0.075 cal per cm^2 per cm per degree C per sec (e.g., copper or cast iron). For casting large ingots, channels 14 for the passage of water are provided in the stool. An opening 16 is also provided in the stool, which is normally filled with a plug 18 of graphite. Metal teemed into the mold strikes against the graphite plug, minimizing melting of the stool on impact.

On the upper surface of the stool is placed a stainless steel tubular metal mold 22, preferably big-end-up. The mold wall thickness is about 0.4 in.

At the upper end of the mold is placed an open-ended ceramic hot top 30. Around the exterior of the mold and the hot top is a layer of heat insulating material 38 (e.g., a layer of sand about two in. thick) retained in place by a shell 40. Above the hot top is a heater 41, consisting of a shell 42 containing a refractory ceramic cap 44. The cap has an opening 46 in it, through which molten metal may be teemed, after which it is closed with a graphite plug 48. Through the sides of the heater are placed hollow, electrically insulating refractory members 50 (e.g., sillimanite). Passing through these are two carbon rods 54 and 56 across which an arc 58 is drawn. Radiant energy from the arc is radiated directly and reflected by the parabolic surface 60 onto the upper surface of the ingot, maintaining most of the metal in the hot top molten. A sight hole 66 permits observation of the arc.

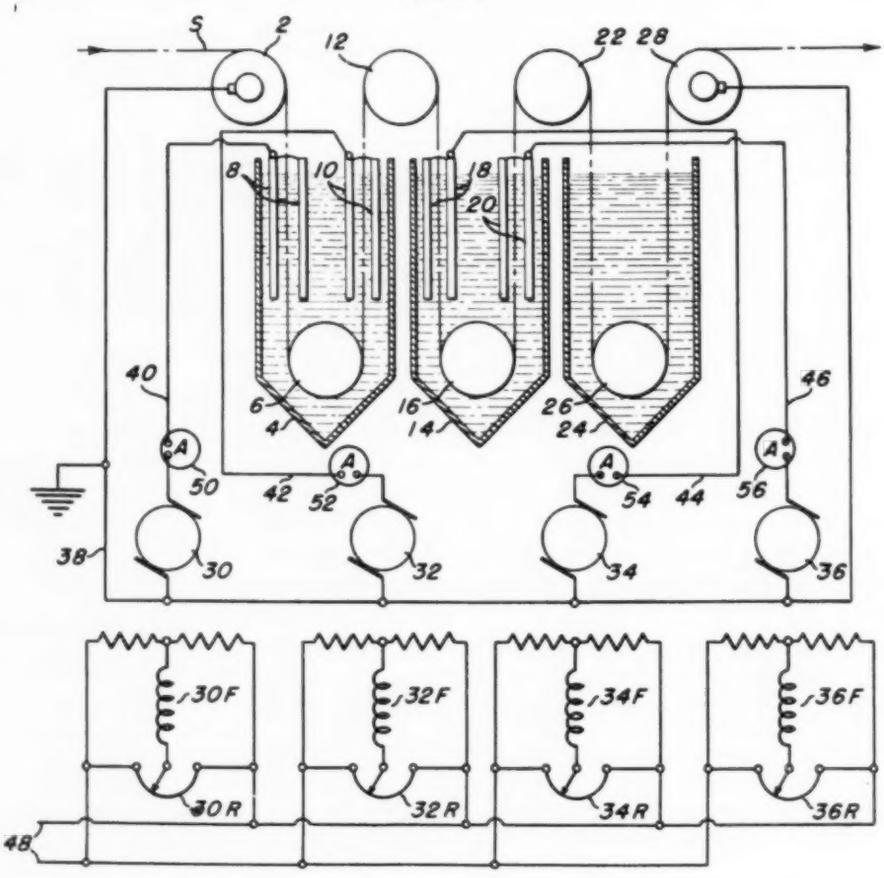
There must be maintained a correlation between the heat-absorbing capacity of the metal stool 12, the thickness of the tubular metal mold 22, and the amount of insulating material 38, so that there is present within 15 min after teeming, a temperature difference of at least 200 C., between the bottom of the metal mold and its midpoint.

COMBINED BESSEMER-OPEN HEARTH FURNACE

▲ U. S. 2,759,722, issued Aug. 21, 1956, to Lester D. Savage, Jr., describes a furnace which is a combination of a side-blown bessemer converter and a basic open hearth furnace. The exothermic heat created in the bessemer provides the flame over the melt in the open hearth furnace. The bessemer and open hearth are also connected so that pure metal settling in the bottom of the bessemer will flow into the lower portion of the open hearth.

As shown in Figure 5, a conven-

Figure 6



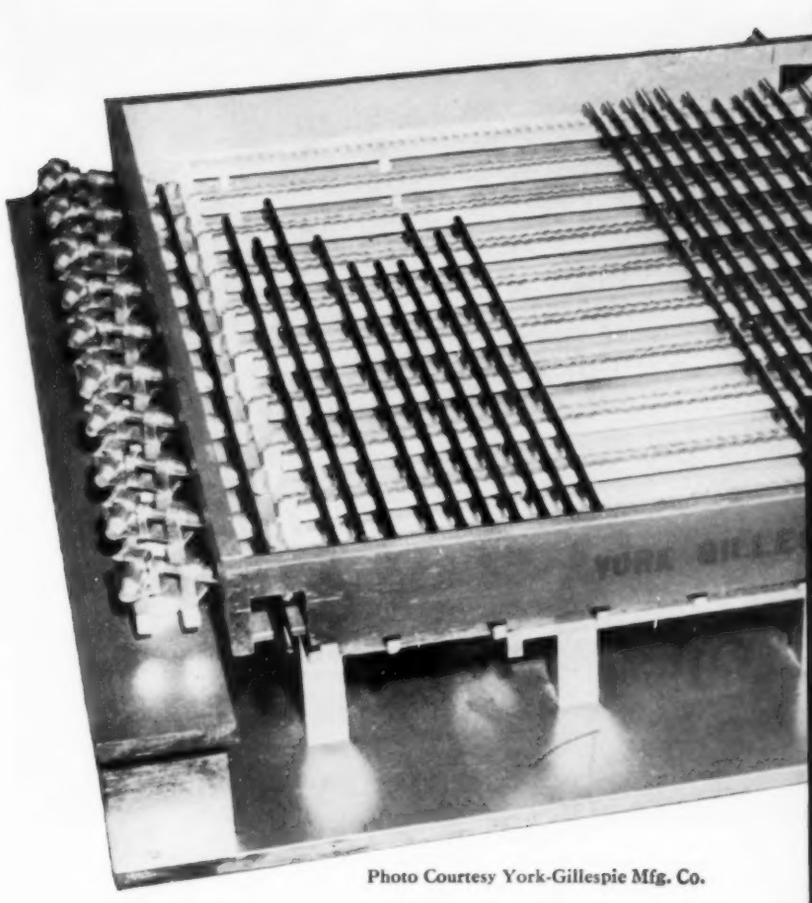
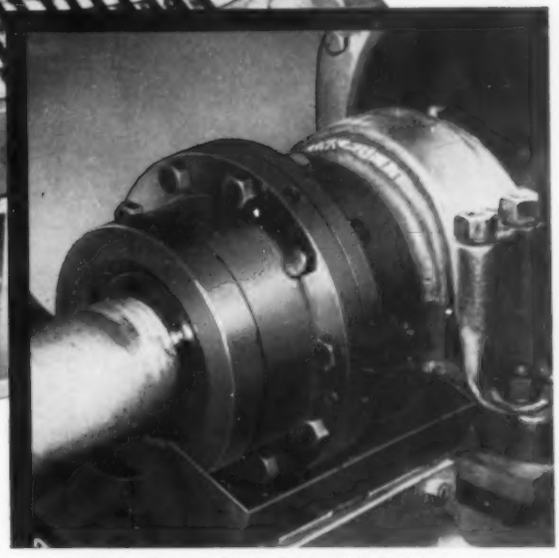


Photo Courtesy York-Gillespie Mfg. Co.



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tional open hearth furnace 10 has a bessemer converter unit 16 attached at the side, providing an auxiliary metal basin 17 and combustion chamber 21.

In operation, the open hearth furnace is charged in the normal manner with molten pig iron and scrap. Some of the melt flows through passages 30 and 31 into the bessemer basin 17, the capacity of which is about 1 to 10 per cent of the furnace melt capacity. When the open hearth furnace is filled to its normal melt line 15, the melt level in the basin will come approximately to the mouths of the tuyeres 26, through which air or oxygen is then blown. The melt lying in the converter will be rapidly purified, and an acid slag S will form on the melt M. The hot products of combustion circulate over the melt in the bessemer and then enter the open hearth furnace through the port 28.

As the upper strata of melt in the basin 17 loses its silicon, carbon, etc., it increases in density, settles to the bottom of the basin, and passes through passage 31 into the bottom of the open hearth furnace. At the same time, this liquid is replaced by liquid re-entering from passage 30. This circulation is accelerated by the oxygen blast from the tuyeres 26.

MANUFACTURE OF CAST IRON WITH REFINED GRAPHITE STRUCTURE

▲ U. S. 2,759,812, issued Aug. 21, 1956, to Hiroshi Sawamura, describes a process of manufacturing cast iron characterized by a highly refined eutectic graphite structure. The process involves the use of a molten slag containing at least 1.0 per cent of titanium in the form of titanium dioxide.

The graphite is refined because a small amount of TiC is scattered as very fine granules in the eutectic mixture and prevents the development of crystals of Fe_3C or of crystals of graphite.

ELECTROLYTIC PICKLING APPARATUS

▲ U. S. 2,759,888, issued Aug. 21, 1956, to George H. Rendel and assigned to United States Steel Corp., describes an apparatus for pickling strip in which a strip passes through a number of passes through an electrolyte. Individual control of current density and polarity in the various passes is made possible, without the use of intermediate conductor rolls.

As shown in Figure 6, the strip S passes through the acid electrolyte in the tanks 4 and 14 between the electrodes 8, 10, 18 and 20, then through the wash tank 24 where the acid is washed off. Current is supplied each electrode by respective generators 30, 32, 34 and 36. Rolls 6, 12, 16, 22 and 26 are rubber insulated. The amount and direction of the current flowing to the various electrodes and to the conductor rolls 2 and 28 is varied by changing the position of the arm of the rheostats 30R, 32R, 34R and 36R.

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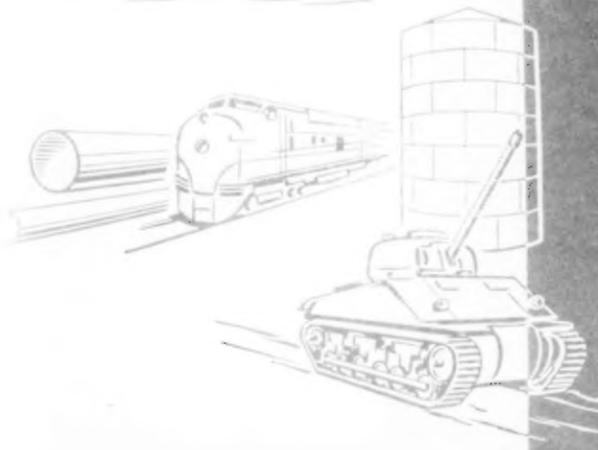

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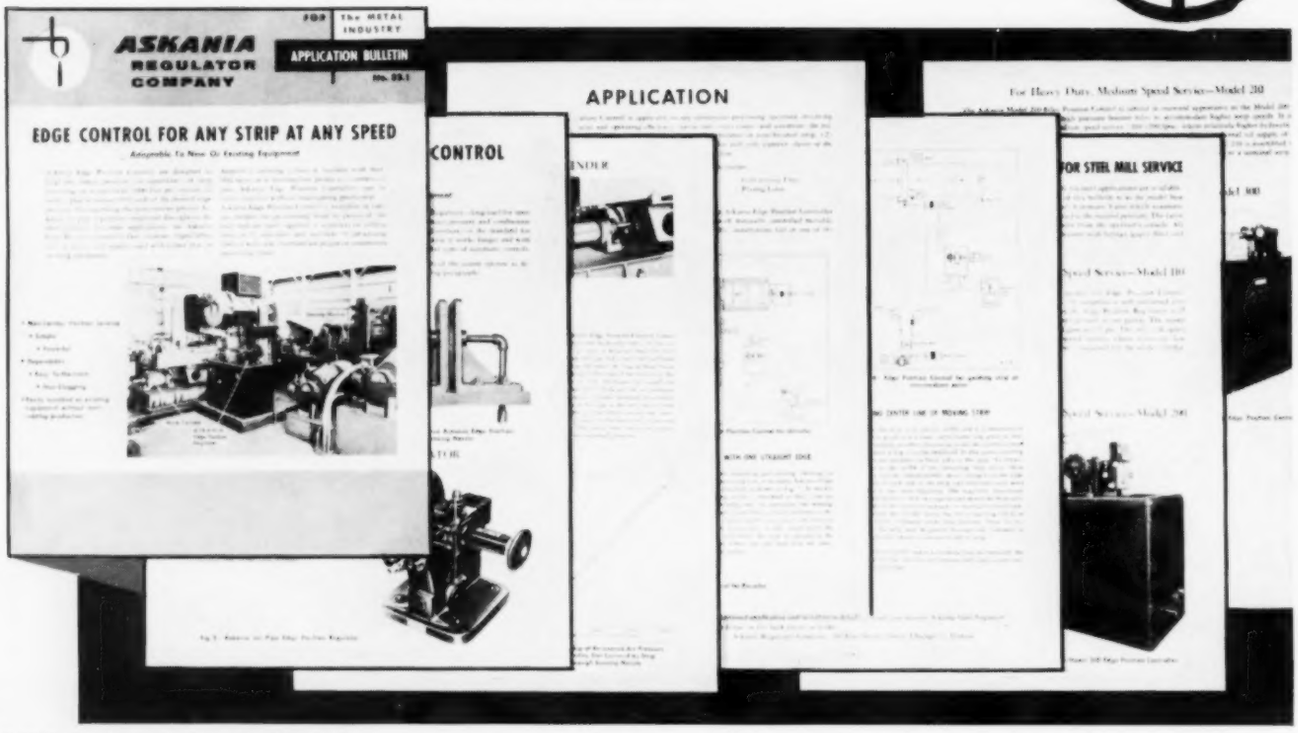

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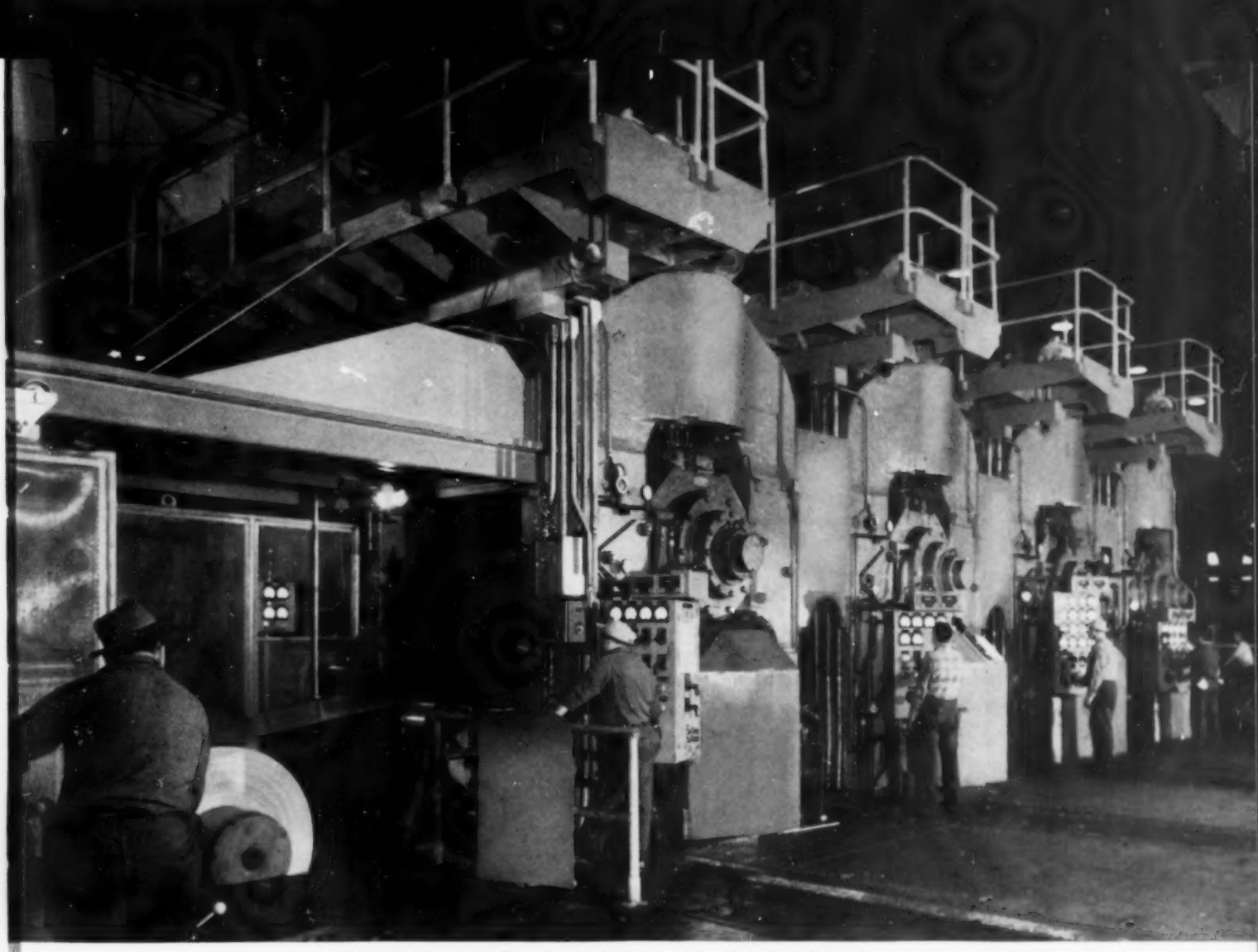

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MAGAMP REGULATOR CONTROL—Generator(s) for each stand and reel power supply is controlled by a Magamp voltage regulator, operating on 400-cycle, three-phase supply from an alternator set.

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TENSIOMETERS—Units between stands indicate total tension and difference in tension between two edges of the strip.

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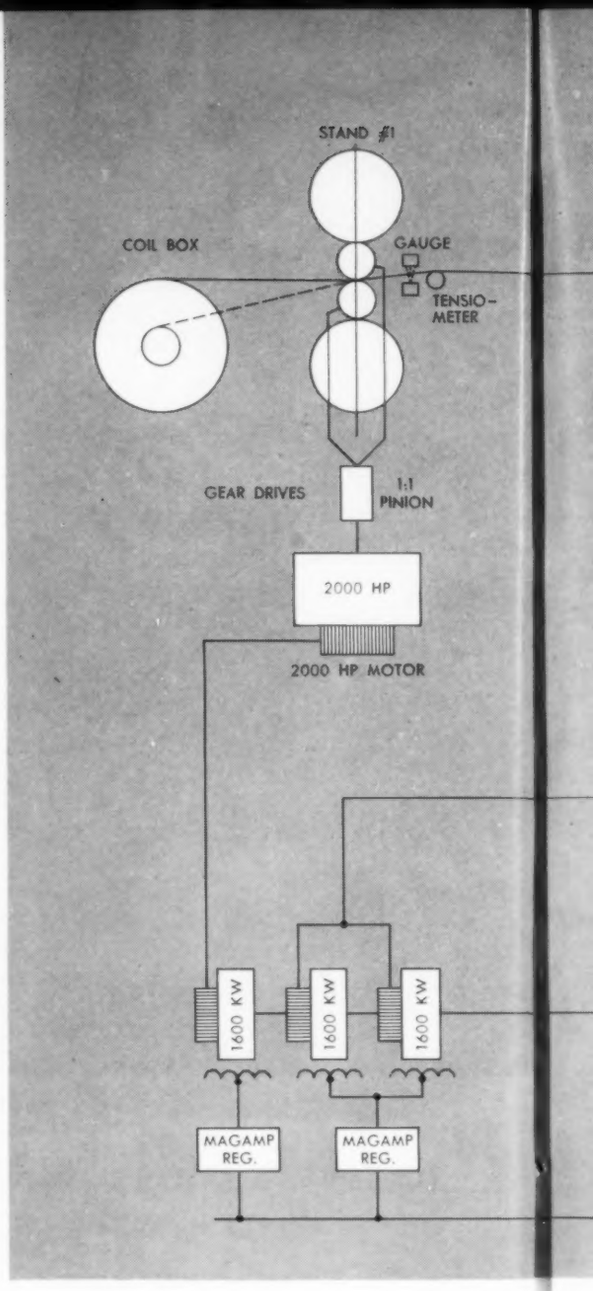
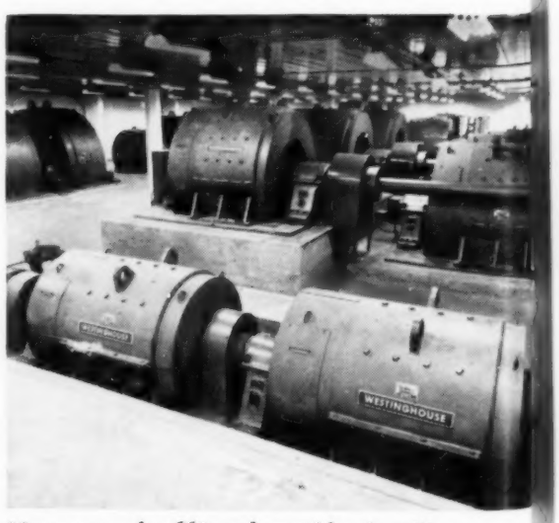
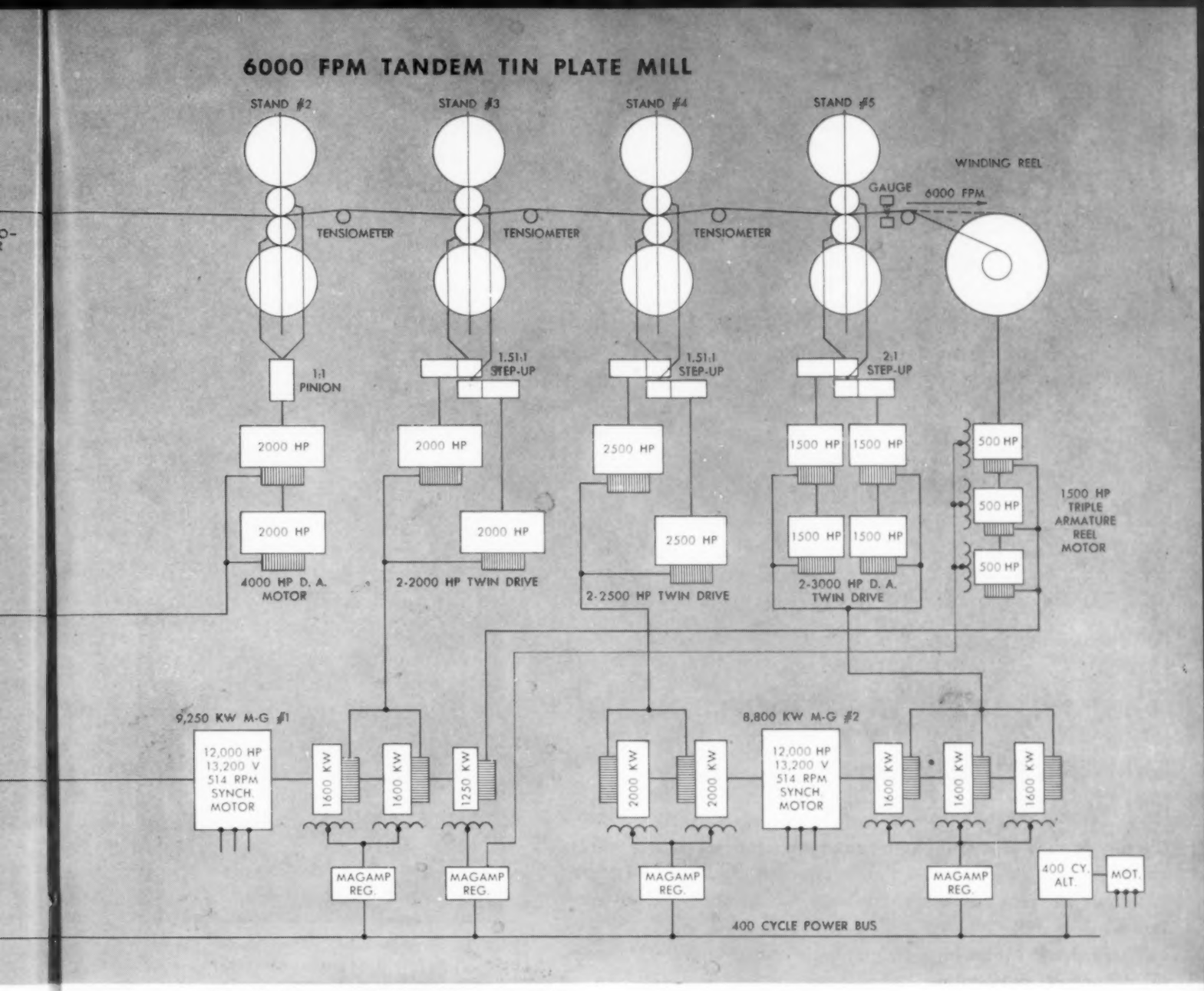
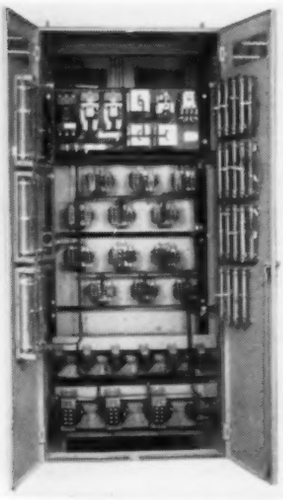




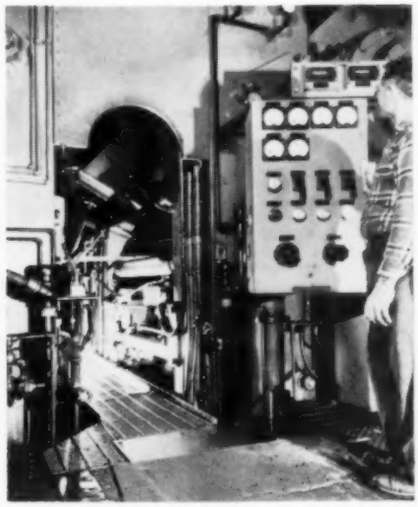
Motor room for 66" tandem cold strip mill.



A 48"-wide five-stand mill like this is now under construction for the Wheeling Steel Corporation. It will have 22,500-hp total drive capacity to produce tin plate and heavier strip at speeds up to 6050 fpm.



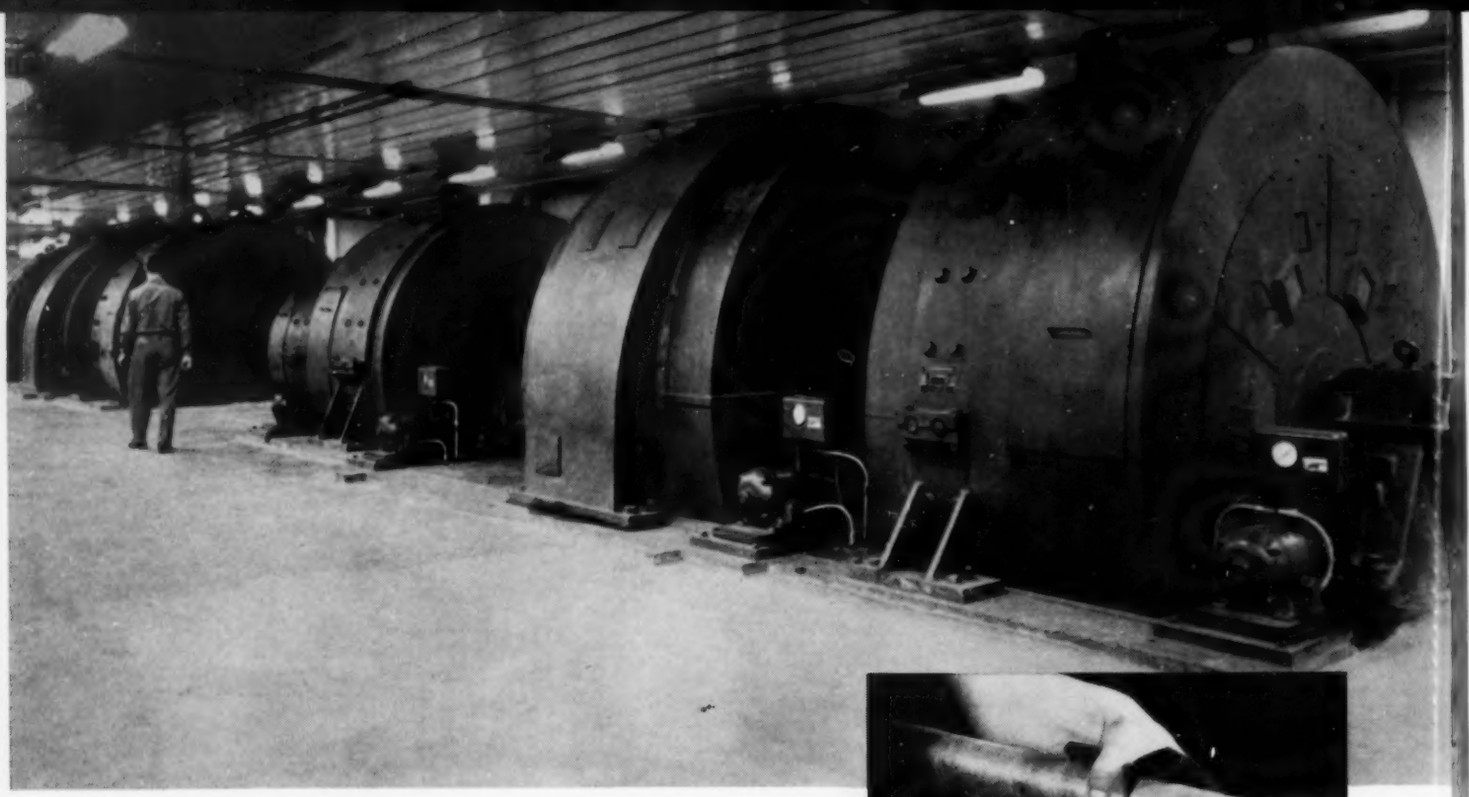
Magamp regulator cabinet.



Tensiometer between mill stands.

Progressive users of Magamp regulator control on tandem cold strip mills

PLANT	YEAR	STANDS AND WIDTH	DELIVERY FPM	TOTAL HP
Pittsburgh Steel Co. Allenport, Pa.	1954	4—66"	1595/3190	17,700
Alan-Wood Steel Co. Conshohocken, Pa.	1954	4—32"	1100/2293	6150
Empire Steel Corp. Mansfield, Ohio	1955	4—52"	747/1868	8100
Usinor Montataire, France	1956	4—66"	1375/3630	19,450
Nonferrous—Ohio	1956	4—32"	850/2075	4400
Steel Mill—Ohio	1957	3—80"	747/1670	13,000
Wheeling Steel Corp. Yorkville, Ohio	1957	5—48"	2750/6050	22,500



Westinghouse Exclusive!

Thermalastic® insulation excels in punishing steel mill duty

Twenty percent greater dielectric strength, ten times greater voltage endurance, 30 times greater tensile strength . . . that's Thermalastic, an amazing insulation available exclusively from Westinghouse.

Thermalastic shrugs off moisture, high voltage and dirt . . . helps Westinghouse motors and motor-generator sets better withstand severe steel mill operating conditions.

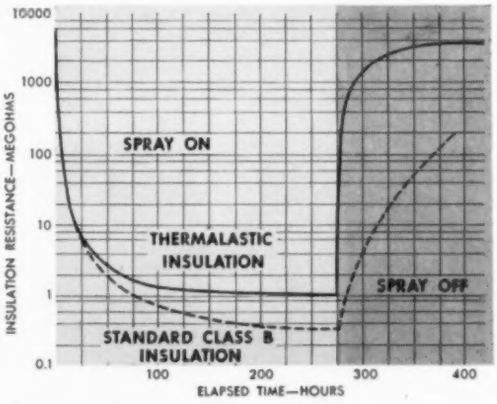
A chemically stable, highly moisture-resistant impregnating resin is used in Thermalastic. This, plus a high degree of fill achieved in the impregnating process, gives Thermalastic extraordinary properties that extend its life in hard service.

Remember, too, Westinghouse switchgear, control centers, ventilation equipment, and gearing are excellent working partners for your Westinghouse coordinated mill drive systems.

From planning to design, installation and start-up . . . Westinghouse is at your service. An experienced Westinghouse team will accept unit responsibility, and work with your engineering staff and consulting engineers in setting up your tandem mill drive.

Contact your Westinghouse sales office for further details. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. MP-3046

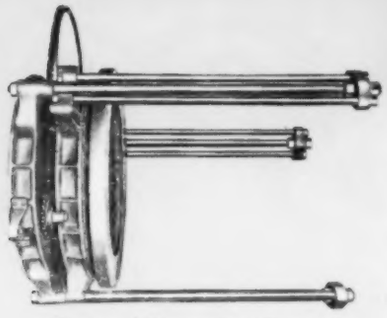
Thermalastic-insulated Westinghouse motor-generator sets (top photo) for 66" four-stand tandem cold strip mill.



Results of typical laboratory spray test demonstrate superior moisture resistance of Thermalastic compared to regular insulation.

YOU CAN BE SURE...IF IT'S

Westinghouse



Thermal Expansion Type

Linear expansion of the thermal tubes frees the goggle plate for swinging to open or closed position. The contraction of the tubes clamps the plate, forming a gas-tight seal. Sizes: 36" to 120".

Mechanical Type

Powerful clamping force applied at all points around disc periphery provides a safe seal for gas mains from 6" to 84".

Bailey

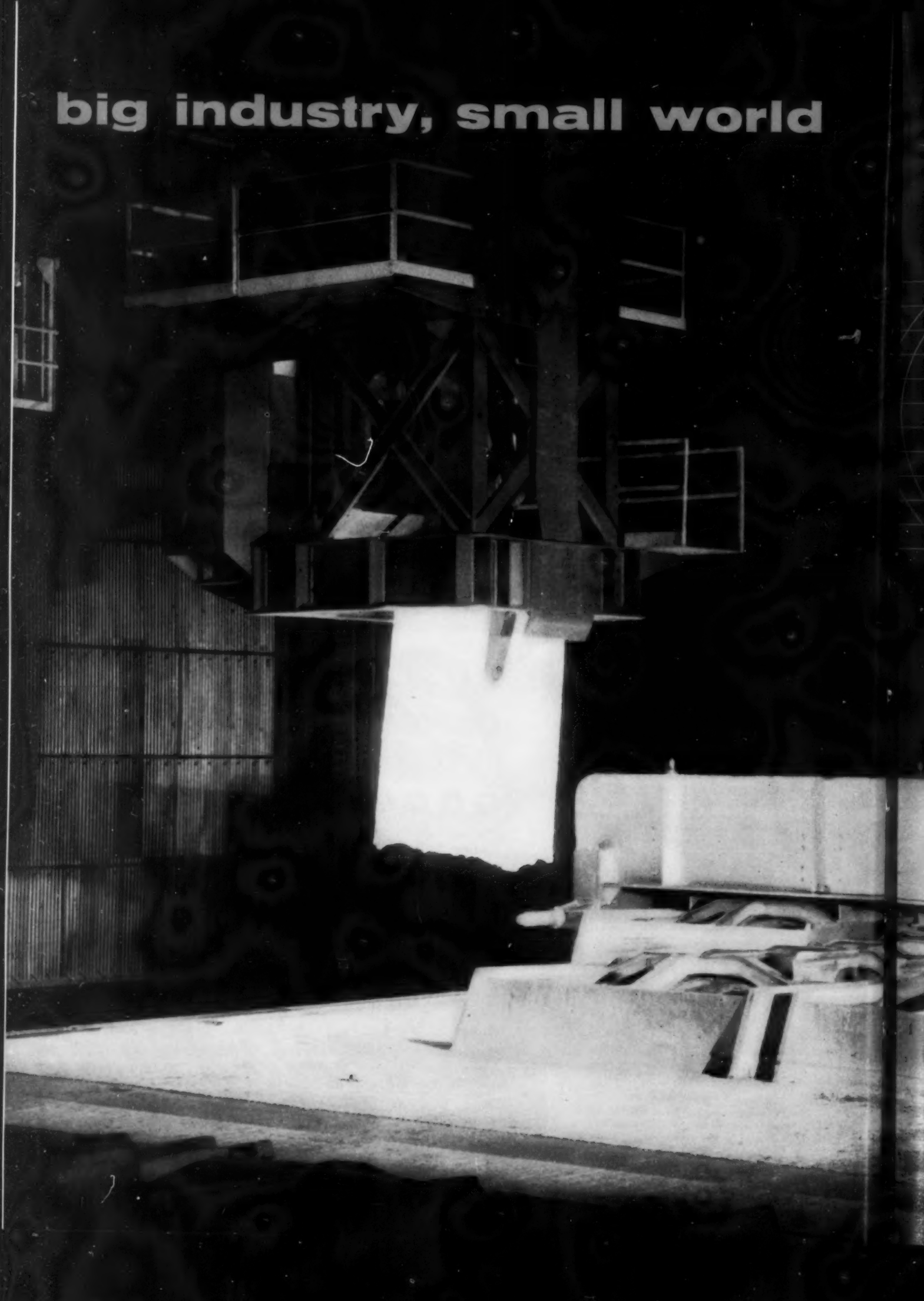
GOGGLE VALVES

Bailey Valves assure safety plus efficient service on gas washers, blast furnace mains, precipitators and boiler plants. Bailey Valves operate satisfactorily, regardless of the length of time they may stand unused. Their dependability has been proven thoroughly by hundreds of installations in major steel plants.

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY

1221 BANKSVILLE ROAD PITTSBURGH 16, PA

big industry, small world



annealing covers
billet reheating furnaces, continuous
carbon restoration and annealing furnaces, continuous
controlled atmosphere generators
high-speed stress relieving furnaces
one-way fired soaking pits
pit-type annealing furnaces
slab and billet heaters, continuous
strip annealing furnaces, continuous
strip galvanizing lines, continuous
wire patenting furnaces, continuous

Wherever this steel goes—from first soak to final shipping dock—it will find that the big steel industry is a small world as far as 'Surface' equipment is concerned. Somewhere along the line, whatever its destined shape, the steel will be made more workable and more useful in 'Surface' furnaces.

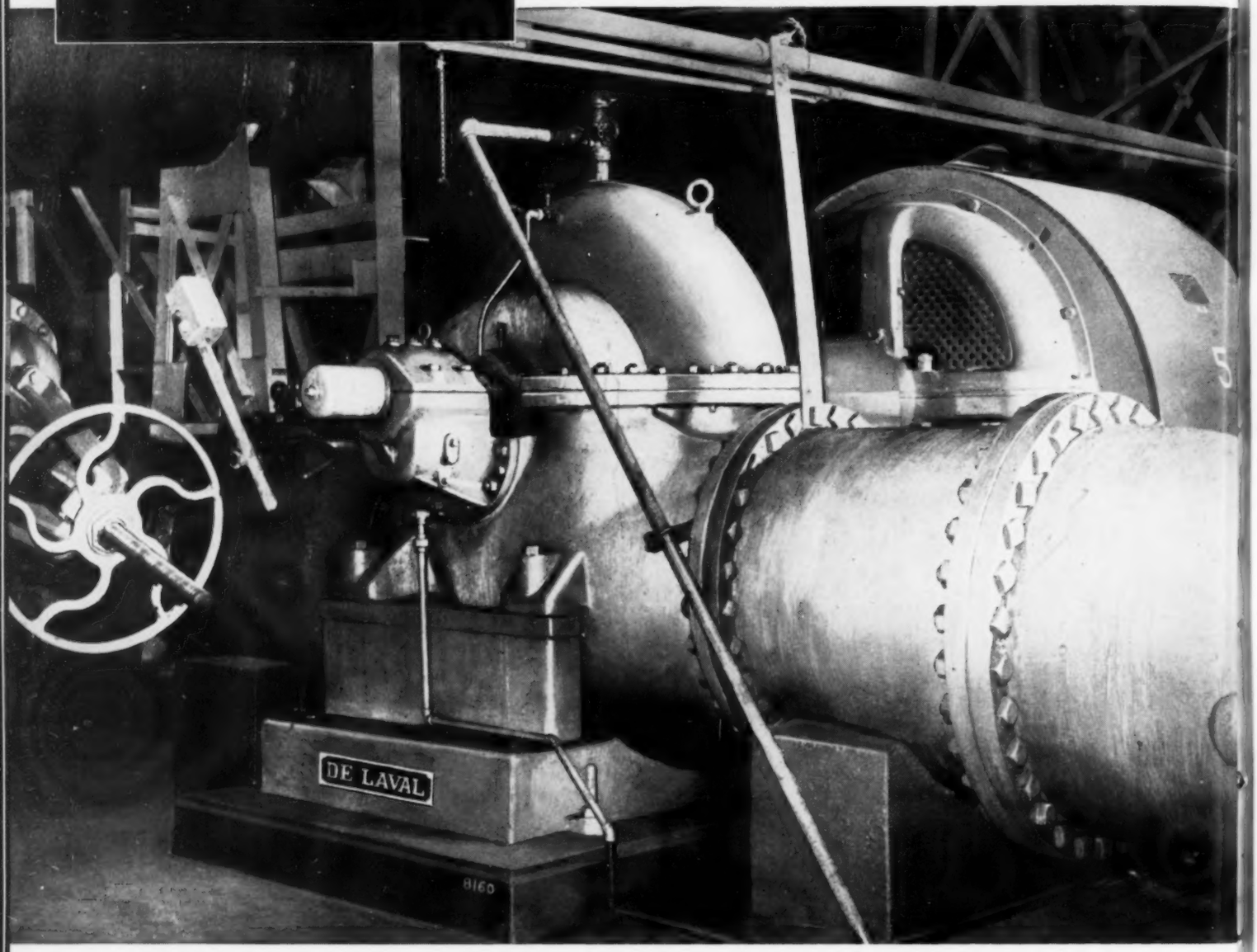
Why is it so easy to bump into 'Surface' in steel mills? One reason is that 'Surface' has literally grown up with the steel industry. A better reason is the confidence that steelmakers have in the performance of furnaces and generators manufactured by Surface Combustion Corp., Toledo 1, Ohio.

Surface
STEEL MILL FURNACES

Foreign associate companies
British Furnaces, Ltd., Chesterfield; Stein & Atkinson, Ltd., London
Stein & Roubaix, Paris, Leige, and Genoa; Chugai Ro Kogyo Kaisha, Ltd., Osaka
Benno Schilde Maschinenbau, A.G., Bad Hersfeld (Hessen, Germany)

DE LAVAL
CENTRIFUGAL PUMPS

in service since 1911 at Inland Steel Co.



De Laval Centrifugal Pumps have a record of dependability at the Inland Steel Co., which goes back forty-five years. In that time, De Laval has supplied this major producer with pumps for practically every steel mill service—*more than 75 units in all.* The photograph shows one of the largest De Laval pumps on the line at the East Chicago, Indiana plant of Inland Steel. The unit delivers 20,000 gpm at 120 ft head.

De Laval Centrifugal Pumps are available for a wide range of applications in all types of metal-working plants. Types L, M and P single stage double suction pumps can handle capacities from 1,000 to 20,000 gpm and heads to 350 feet. Larger De Laval units of any capacity to meet any requirement for steel mill service are available.

Send for Bulletin 1004 giving performance and application data.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
870 Nottingham Way, Trenton 2, New Jersey

Not just for your special-purpose motors . . .

General-purpose motors also deserve

NATIONAL
TRADE-MARK

Carbon Brushes

Get the right commutating ability for the particular type of motor and the given service conditions

For regular duty a handsome choice of grades with proven dependability...

N-4 SA-45 SA-35 255

For unusual duty light or severe, many specialized grades including...

SA-4548 SA-3538 258

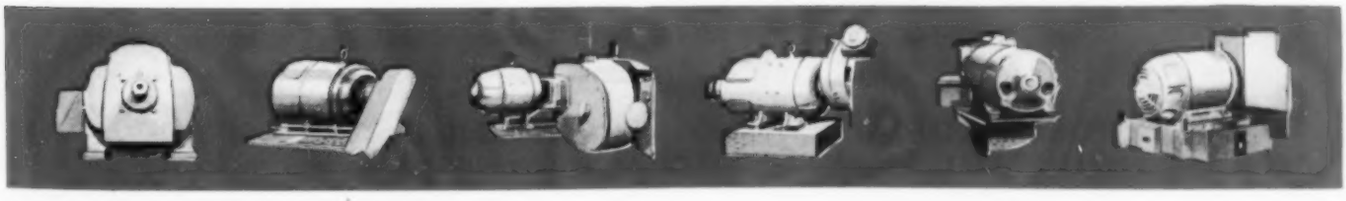
SA-4542 SA-3532

Whether it's 5 or 250 h.p.....light or heavy duty...motor or generator...the right brush pays big dividends in efficient output and long equipment life. Whenever you have a problem concerned with brush performance and commutation, feel free to call on NATIONAL CARBON for specialized advice.

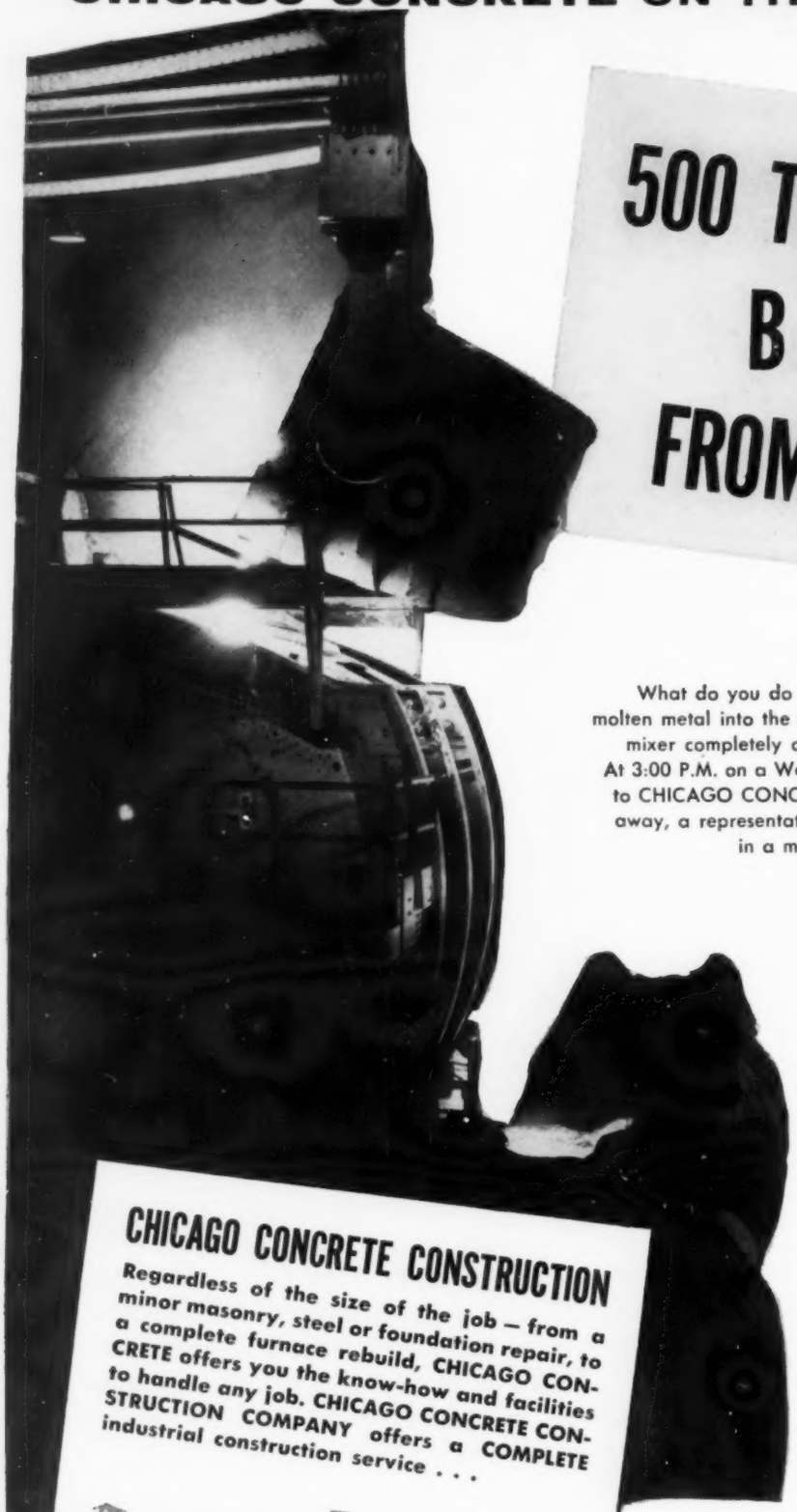
The term "National", the Three Pyramids Device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY • A Division of Union Carbide and Carbon Corporation • 30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. *In Canada:* Union Carbide Canada Limited, Toronto



CHICAGO CONCRETE ON THE JOB IN HOURS



500 TONS OF METAL BLASTED FROM SCALE PIT

What do you do when a mixer accidentally pours 500 tons of molten metal into the scale pit of an open hearth shop, putting the mixer completely out of production?

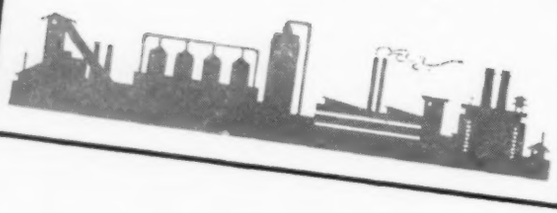
At 3:00 P.M. on a Wednesday in April, 1953 that question was put to CHICAGO CONCRETE. Although the job was over 2,000 miles away, a representative was on the scene appraising the damage in a matter of hours. Simultaneously he ordered out the manpower and equipment necessary to repair the damage while setting to work available manpower in cleaning up. Then . . . coupling the experience bred of 35 years of operation with the judicious use of dynamite, CHICAGO CONCRETE went to work. WITHIN DAYS THE ENTIRE MASS WAS REMOVED AND THE MIXER READY TO RETURN TO ITS JOB.

PRODUCTION TIME SAVED . . . 35 DAYS

By tried-and-proven-safe methods, CHICAGO CONCRETE removed that 500 tons of metal from the scale pit — taking care to safeguard the mixer itself throughout the entire operation. The savings to this mill in "down-time" was literally tens of thousands of dollars. This is another of many emergencies handled by CHICAGO CONCRETE every day, every week . . . handled by experienced men employing the utmost speed. You, too, can depend on CHICAGO CONCRETE in ANY emergency

CHICAGO CONCRETE CONSTRUCTION

Regardless of the size of the job — from a minor masonry, steel or foundation repair, to a complete furnace rebuild, CHICAGO CONCRETE offers you the know-how and facilities to handle any job. CHICAGO CONCRETE CONSTRUCTION COMPANY offers a COMPLETE industrial construction service . . .



CHICAGO CONCRETE BREAKING CO.

12233 S. AVENUE "O", Chicago 33, Ill., BAyport 1-8400

PITTSBURGH AREA - 213 Corey Ave., Braddock, Pa., Electric 1-1656

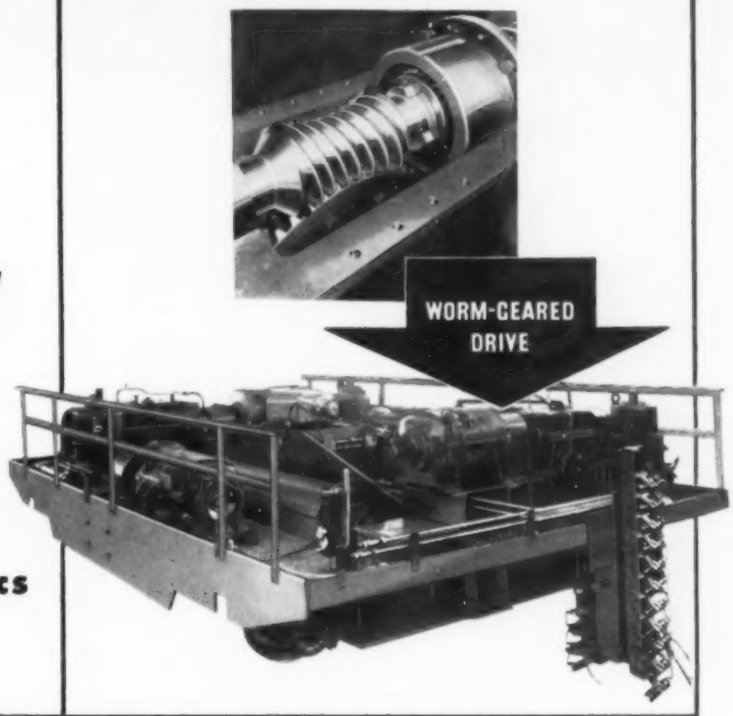
SERVING THE PRIMARY METALS AND OIL INDUSTRIES WITH KNOW HOW, EQUIPMENT AND MANPOWER FOR 35 YEARS

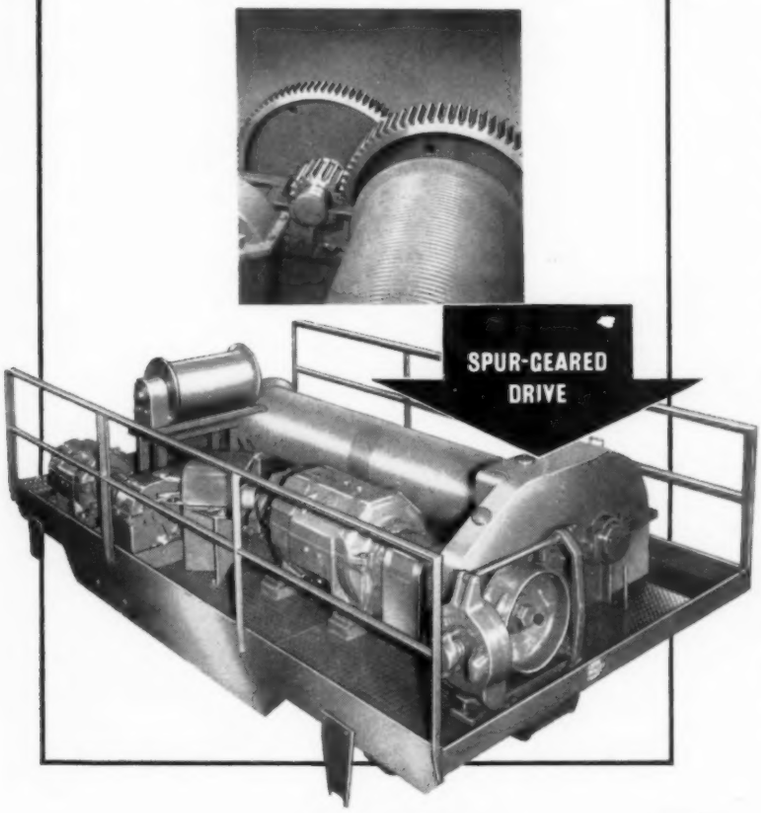
CHOOSE THE TROLLEY

YOU LIKE BEST

SHAW-BOX

Builds both to A.I.S.E. Specs





You want trolleys of the type your experience has proved are best for your particular requirements. The two types of trolleys and their gearing shown here illustrate how A.I.S.E. specifications are interpreted by Shaw-Box in satisfying the needs of two different mill applications.

Whether you prefer worm or spur gearing on your trolleys, turn to Shaw-Box and be sure of the finest in precision manufacture. Our long experience in designing, engineering and building load handling equipment exclusively assure you of continuously dependable performance, regardless of service conditions.

Over the years, we have produced many 5 to 200-ton cranes of various types to A.I.S.E. specifications and to the specifications of individual mills. Their work records prove the economic value of mechanical and operational features conceived and introduced by Shaw-Box. So if your plans include a crane to handle plate or slabs, a soaking pit carriage or a giant ladle crane, we invite your inquiry.

"Shaw-Box"® CRANES

57K-1

MAXWELL MANNING & MOORE INC. M&M TRADE MARK

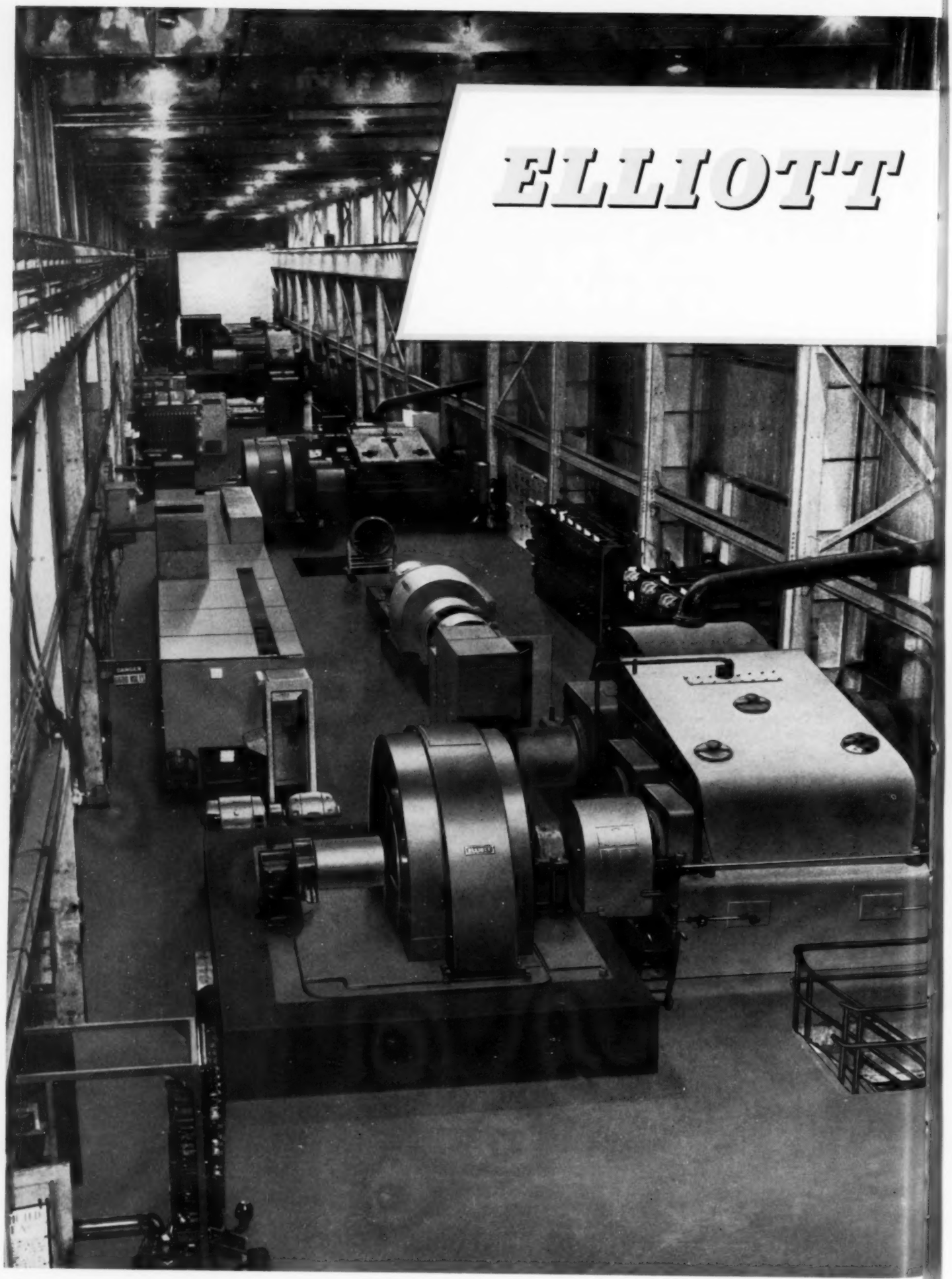
MANNING, MAXWELL & MOORE, INC.

SHAW-BOX CRANE & HOIST DIVISION

388 West Broadway • Muskegon, Michigan

Builders of "SHAW-BOX" and 'LOAD LIFTER' Cranes, 'BUDGIT' and 'LOAD LIFTER' Hoists and other lifting specialties. Other Divisions produce 'ASHCROFT' Gauges, 'HANCOCK' Valves, 'CONSOLIDATED' Safety and Relief Valves, 'AMERICAN' and 'AMERICAN-MICROSEN' Industrial Instruments, and Aircraft Products.

In Canada: ***Manning, Maxwell & Moore of Canada, Ltd., Avenue Road, Galt, Ontario.***


ELLIOTT

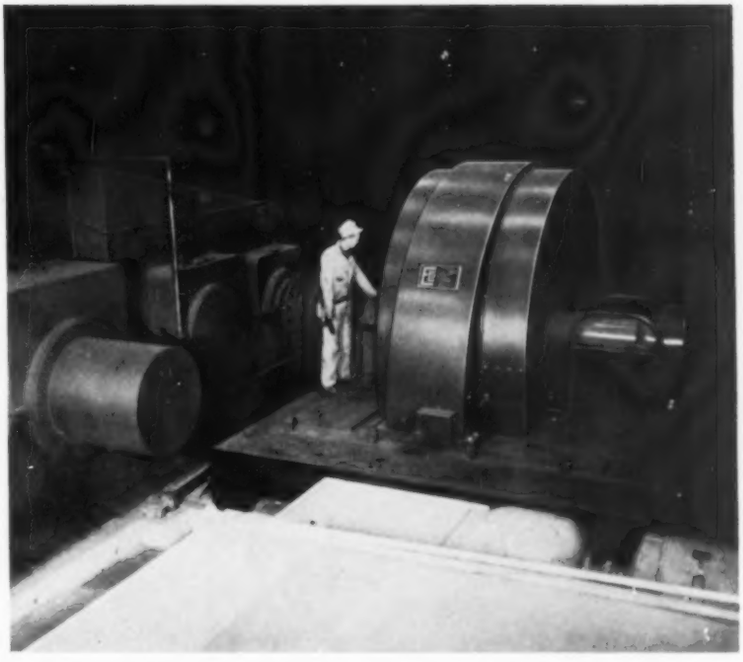
6000-Horsepower SYNCHRONOUS MOTORS

drive new roughing stands in Weirton's 54-inch hot strip mill

FOR DRIVING three roughing stands in the new 54-inch hot strip mill at Weirton Steel Company, a division of National Steel Corporation, Elliott 6000-horsepower synchronous motors were chosen. These motors, which are the largest in the mill, provide exceptionally high pull-out torque. An ingenious feature of the application is the Elliott mechanical "inching drives," which, by applying new principles to an old problem, facilitate fast and economical roll removal and replacement.

The steel industry uses many Elliott steam and electrical products, and they are all represented at Weirton. Large and small motors, strainers of various capacities, blast furnace compressors, steam turbines and condensers, deaerating heaters are among the items supplied to Weirton during the past 40 years.

For complete information on Elliott steel mill equipment, get in touch with the nearest Elliott District Office, or write Elliott Company, Ridgway, Pennsylvania.



FASTEST OF ITS SIZE

Shown above is one of the three 6000-hp, 450-rpm, 6900-volt Elliott motors which drive the new roughing stands of the modernized Weirton 54-inch hot strip mill—the fastest of its size in the industry.

ELLIOTT Company

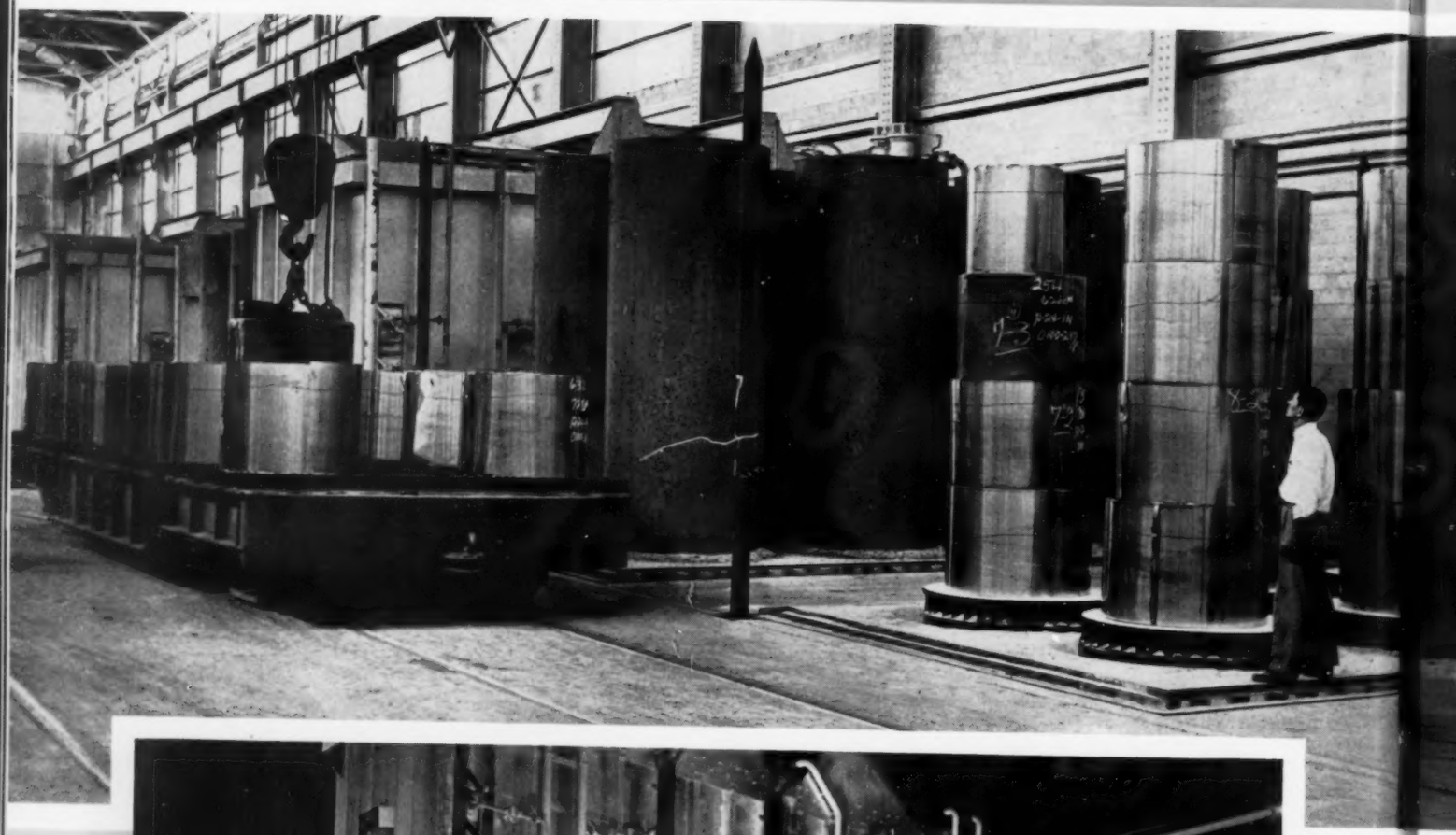
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS
EJECTORS • CONDENSERS • CENTRFIGUAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

R6-25

SWINDELL

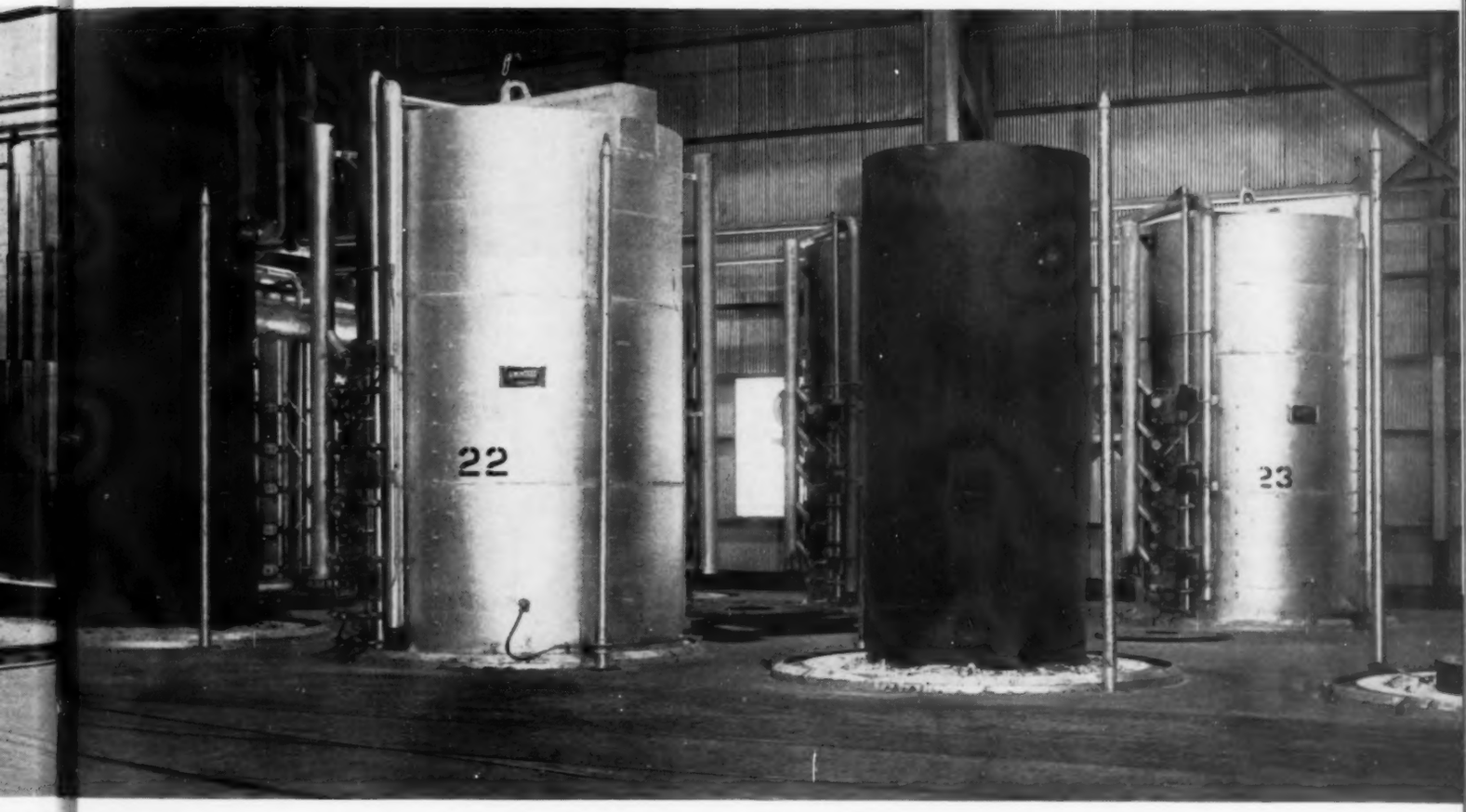
Multi-Stack and Single-Stack

ANNEALING FURNACES



- for better operating efficiency
- and better customer service—

EQUIP WITH BOTH!



Here's why:

When you equip with *both* Swindell Multi- and Single-Stack Annealing Furnaces in the same shop, you profit!

- You render more effective service to your customers because better equipment flexibility enables you to handle efficiently a greater variety of jobs.
- Additional efficiency is gained because operating techniques and procedures are similar for both types.
- You save in parts inventory and maintenance because burners, load bases, inner covers and other major components are interchangeable throughout.

A SWINDELL-DRESSLER engineer will be pleased to provide further information!

SWINDELL-DRESSLER Corporation

DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES

PITTSBURGH 30, PA.

8 good reasons why you should use these ROLLER GUIDES in your bar or wire rod mill

Nos. 125 and 155 roller guides fitted in a 27 1/2 in. (700 mm.) diameter, three-high stand for rolling 2 3/4, 3 3/16, 3 9/16, 4, 4 3/8 and 4 7/8 in. (70, 80, 90, 100, 110 and 124 mm.).

1 The entry friction guides are rigidly clamped into the guide box. They are intended to lead the oval to the groove in the roller, to protect the rollers against overloading, and to straighten bent rods.
The groove in the entry guides is made about 1/8" wider than the oval.

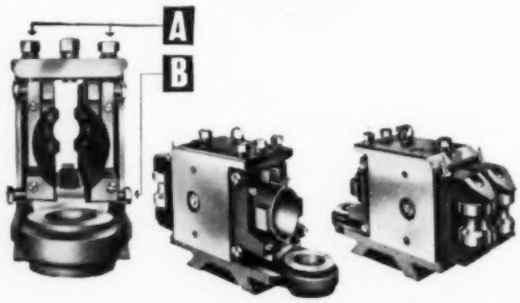
2 The rollers are mounted on leaf springs, which can be adjusted by means of the screws "B", and hold the oval steadily even if there should be some slight variation in the thickness of the oval.

3 If the thickness of the oval should vary, the springs of both rollers yield an equal amount, so that the oval remains in the centre of the groove.

4 To tilt the oval, the screws "A" are adjusted. One roller will then be lifted as much as the other is lowered.

5 As the oval is held very rigidly, the leader oval for wire rod may be thick, unless other circumstances call for a thinner oval.

6 The roller guide assemblies are narrow, and all screws that require adjustment during rolling are accessible from the front of the mill. No lateral space outside the guide box is therefore required for gaining access to the set screws, and the guide box assembly can thus be located close to the mill housing.



7 As the groove in the entry guides is wide and nothing but rolling friction acts on the oval, the latter is very easily introduced into the pass, and there is practically no risk of scratching the bar.

8 The roller guide may be used not only for leader and drawing oval passes but also for edging flats as well as for rolling squares, hexagons, octagons and various other sections, for instance in reduction passes for hexagon. It is suitable for all types of rolling mill. An important advantage is that the roller guide enables repeaters to be used in rolling plump leader-ovals.

PS *Practically speaking, every bar and wire rod mill in Scandinavia uses roller guides of our design.*

MH **MORGÅRDSHAMMAR**

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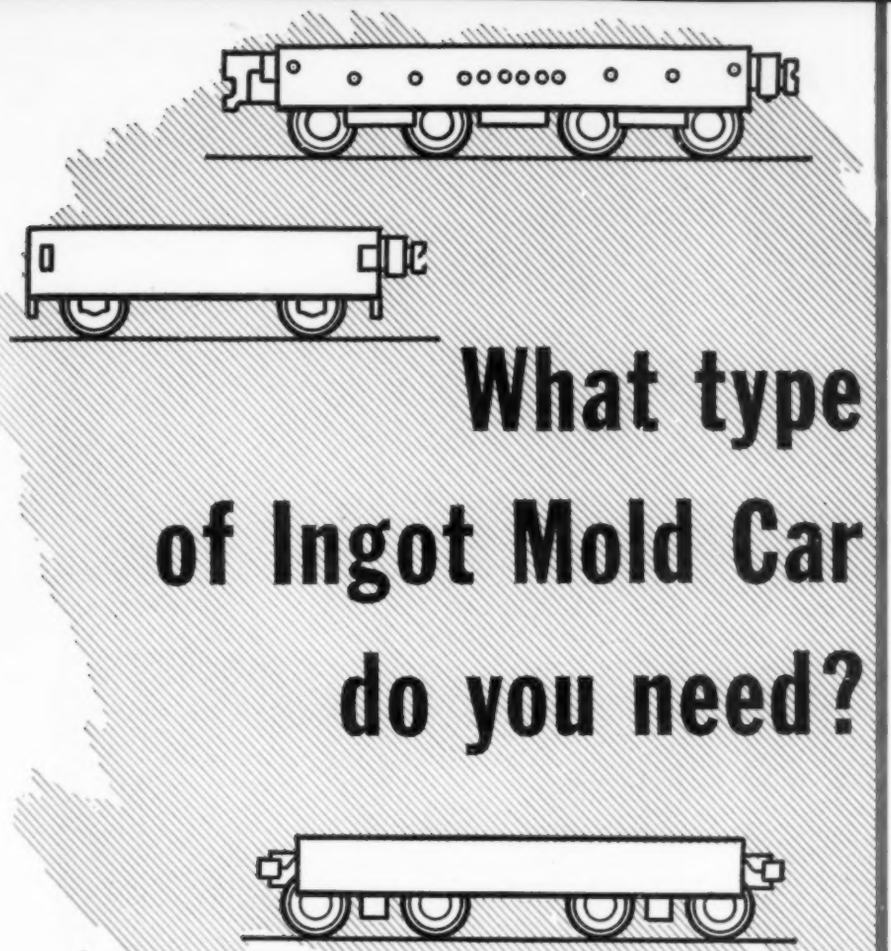
SOLE AGENT FOR THE US:
K.W. Atwater Engineering, Inc.
401-03 Butler Street
Pittsburgh 23, P.A.



What type of Ingot Mold Car do you need?

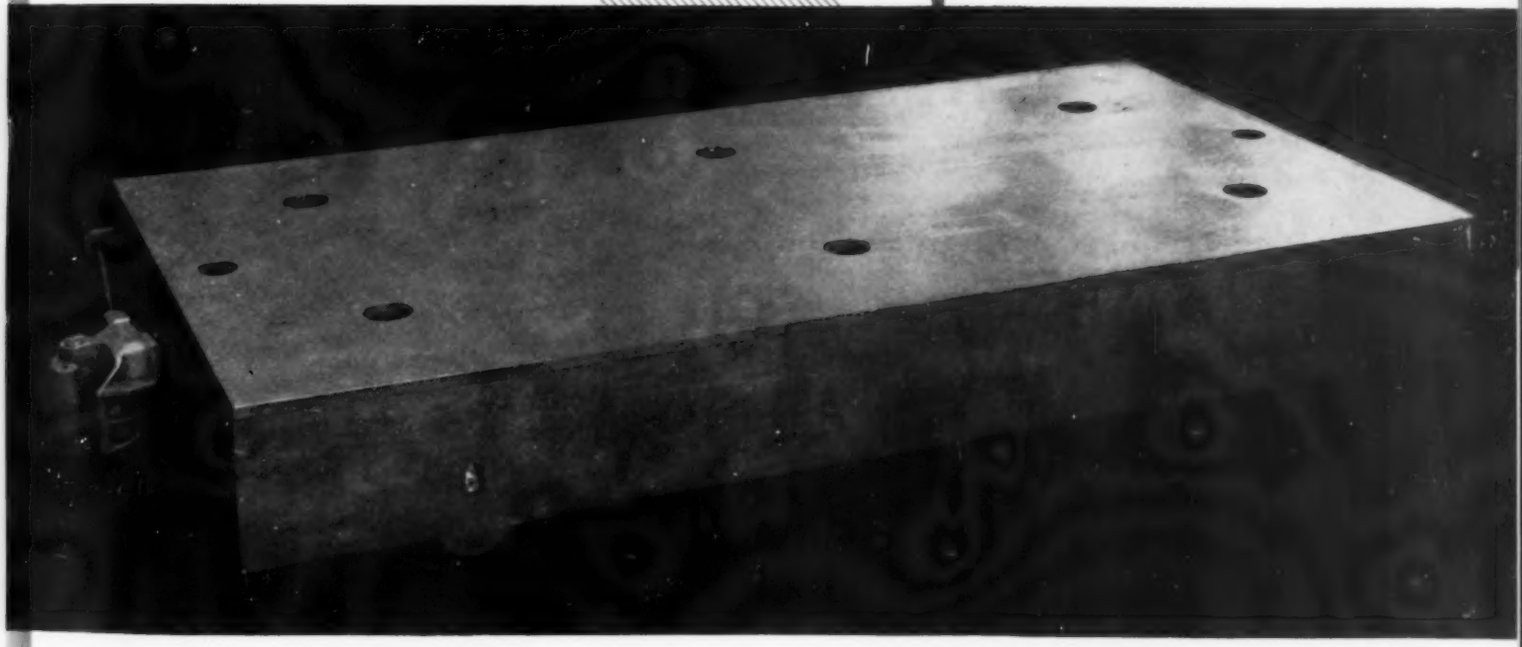
United States Steel specializes in designing and building all types and sizes of cars for industrial uses. Based on operating conditions, we will prepare designs that will meet your specific requirements for industrial transportation.

USS Ingot Mold Cars feature stress-relieved, all-welded steel bodies. These may be either four- or eight-wheel cars and can be equipped with either inboard or outboard bearings.

The capacity of ingot mold cars which we design and build ranges up to 250 tons live load for use on either narrow gage or standard gage track.

Write for a free copy of our booklet, "USS Custom Designed Cars." Our engineers will be glad to consult with you about the design and construction of industrial cars for your needs.

This rugged, all-welded steel ingot mold car is a standard gage, 100-ton capacity, three-stool car, utilizing wrought steel wheels, designed to operate on a 75′-radius curve.



USS INDUSTRIAL CARS

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL

United States Steel Corporation
525 William Penn Place, Room 2801
Pittsburgh 30, Pennsylvania

Please send me a free copy of your 32-page booklet, "USS Custom Designed Cars."

Name .....

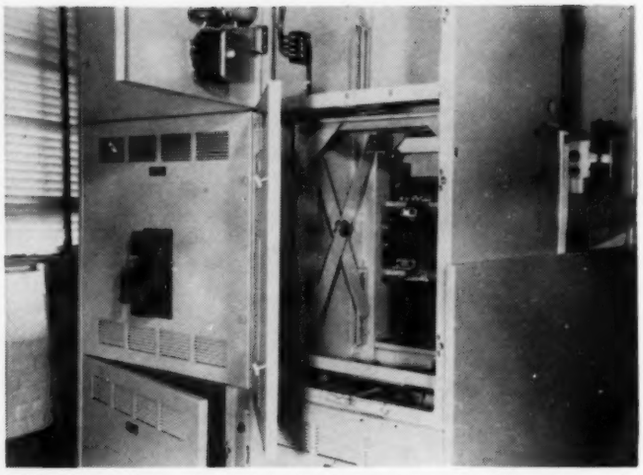
Company .....

Address .....

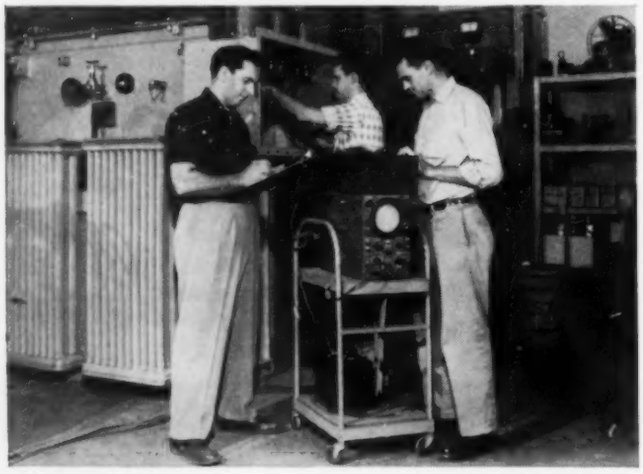
City ..... State.....

SECONDARY UNIT SUBSTATIONS

ENGINEERED AT I-T-E and coordinated to meet the operating conditions found in your plant.



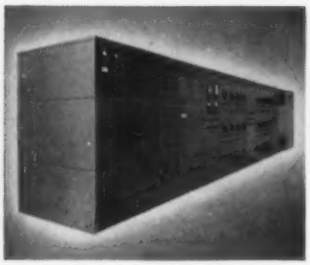
BUILT AT I-T-E with such extra features as circuit breaker test-position with doors closed.



TESTED AT I-T-E to assure ease of installation, and top performance under operating conditions.

SHIPPED FROM I-T-E to assure prompt delivery of one complete "package," ready to install.

I-T-E MAKES IT EASY TO BUY COMPLETELY COORDINATED UNITS



Only I-T-E builds transformers and switchgear in the same plant. This permits them to assume all responsibility for your unit substation requirements. Close association of engineering and production relieves you of detailed planning, paperwork, and the problems of coordinating deliveries. Shipment is from one location. Installation is speeded. Substation components are completely integrated to provide top performance at low overall cost.

Typical of the extra value which *only* I-T-E Unit Substations offer is circuit breaker test-position with doors closed—and without removing them. This means additional safety to operating personnel, greater cleanliness, simplified tagging out of circuits, and longer life. I-T-E Secondary Unit Substations can be supplied for any application, indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Or write I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

AS ALWAYS . . . The Year 1957

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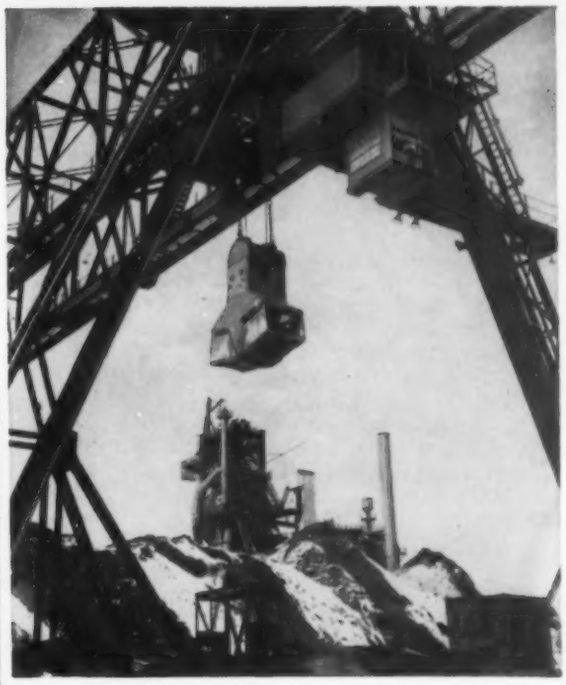

We at H&P blend progressive and imaginative design with technical and manufacturing experience gained from 70 years of designing and building dependable

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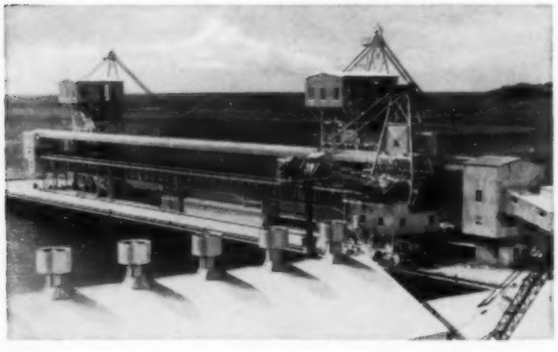

All the way from design to erection, we function as a team dedicated to the task of making your material handling a successful and low cost operation. Thus we meet our responsibility as a leader in our field . . . with efficiency and dependability built into every piece.

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Exclusive with the Heroult:

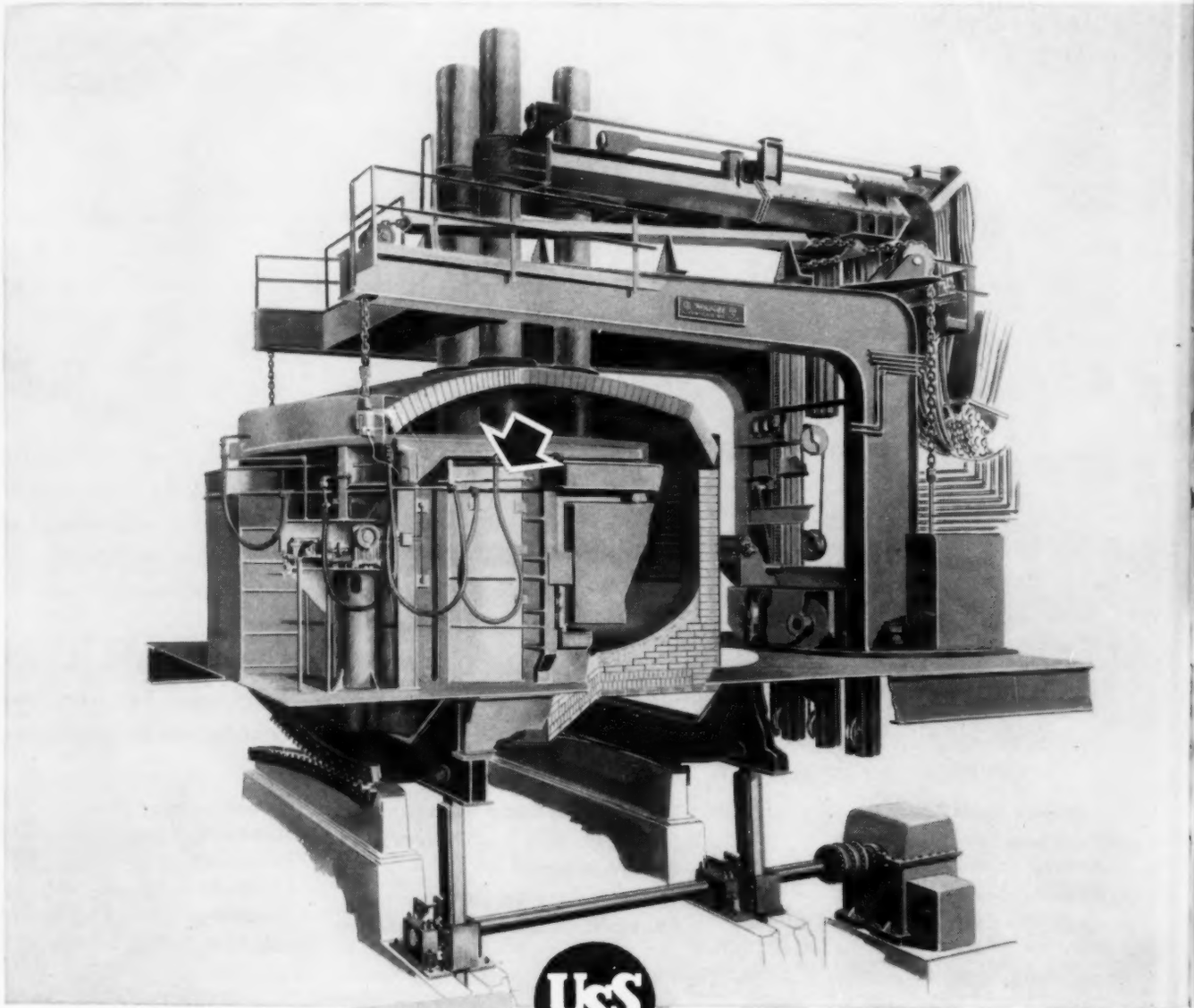
Cage-Type Shell Construction

The Heroult is the only electric furnace on the market with a cage-type shell. In this exclusive design, the shell plates are loosely attached to a heavy structural supporting cage, which allows the plates to expand and contract freely, thus minimizing shell distortion due to extreme changes in temperature. This type of construction also permits easy replacement of damaged shell plates.

This cage-type shell construction is just one of the many advantages you get in the Heroult—advantages which make for performance efficiency, operating economy, and low-cost maintenance. Other exclusive features are: 100% mechanical operation; independently supported operating mechanism; flat bottom shell; and skew back roof ring.

The new Heroult Electric Melting Furnaces are available in sizes of shell diameter ranging from 7′ 0″ up, and with capacities of from 6,000 lbs. up to 400,000 lbs. and greater. They can readily be furnished with a non-magnetic shell bottom section to accommodate induction-stirring equipment. Gantry-type top-charge furnaces, door-charge furnaces, and special furnaces for duplexing and non-ferrous melting can also be supplied.

We welcome an opportunity to help you select and install the Heroult best suited to your requirements. An inquiry to the nearest office will bring complete details.



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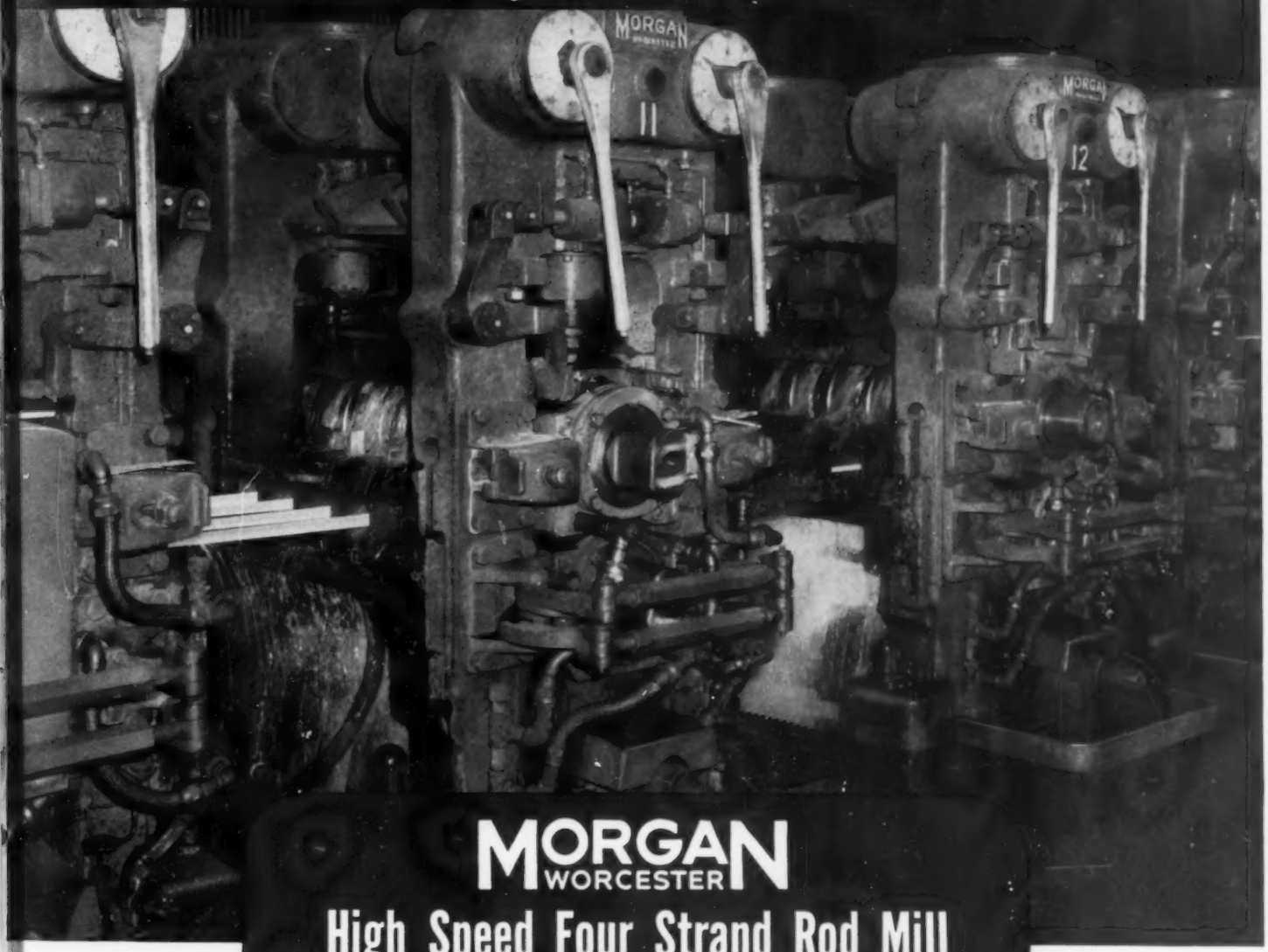

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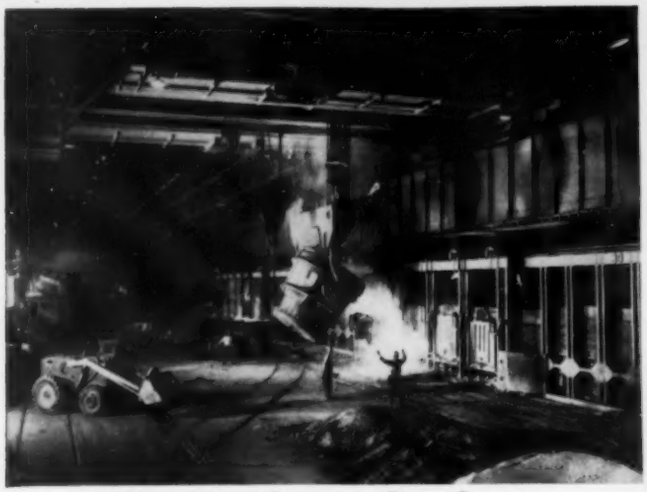
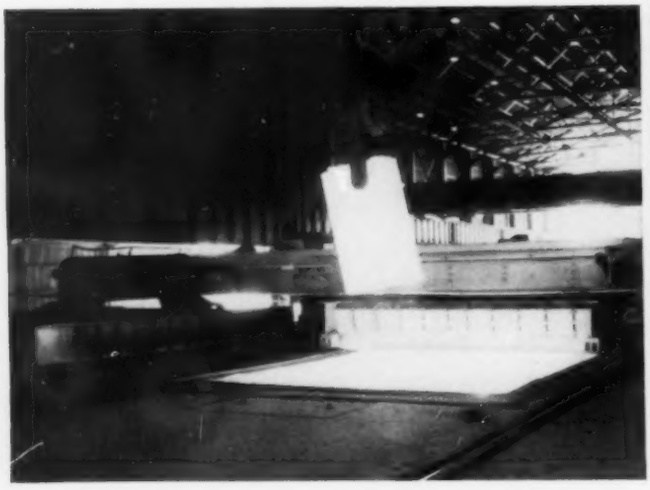


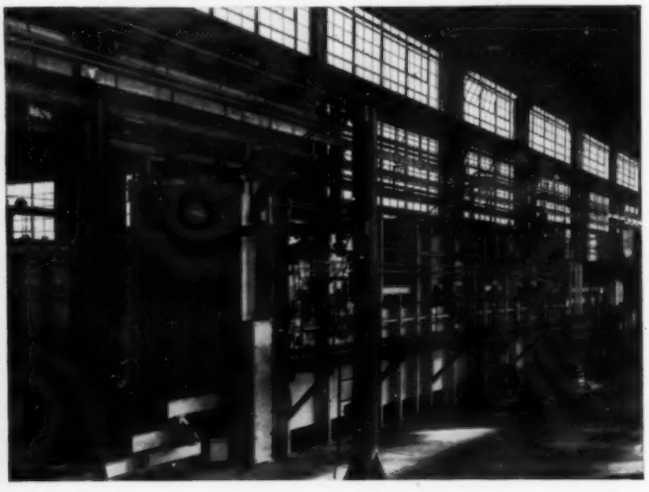
Open Hearth Furnaces—Photo Courtesy
Jones & Laughlin Steel Corp.

Continuous Heating Furnaces—
Photo Courtesy Crucible Steel Co.

Soaking Pit—Photo Courtesy
United States Steel Corp.



Heat Treating Furnace—
Photo Courtesy Taylor Forge & Pipe Works



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Whatever your heating or heat-treating requirements, it will pay you to take advantage of Loftus' long experience in furnace design and construction. Many of the world's leading companies have—and to their utmost satisfaction, as proved by the high percentage of repeat orders we get.

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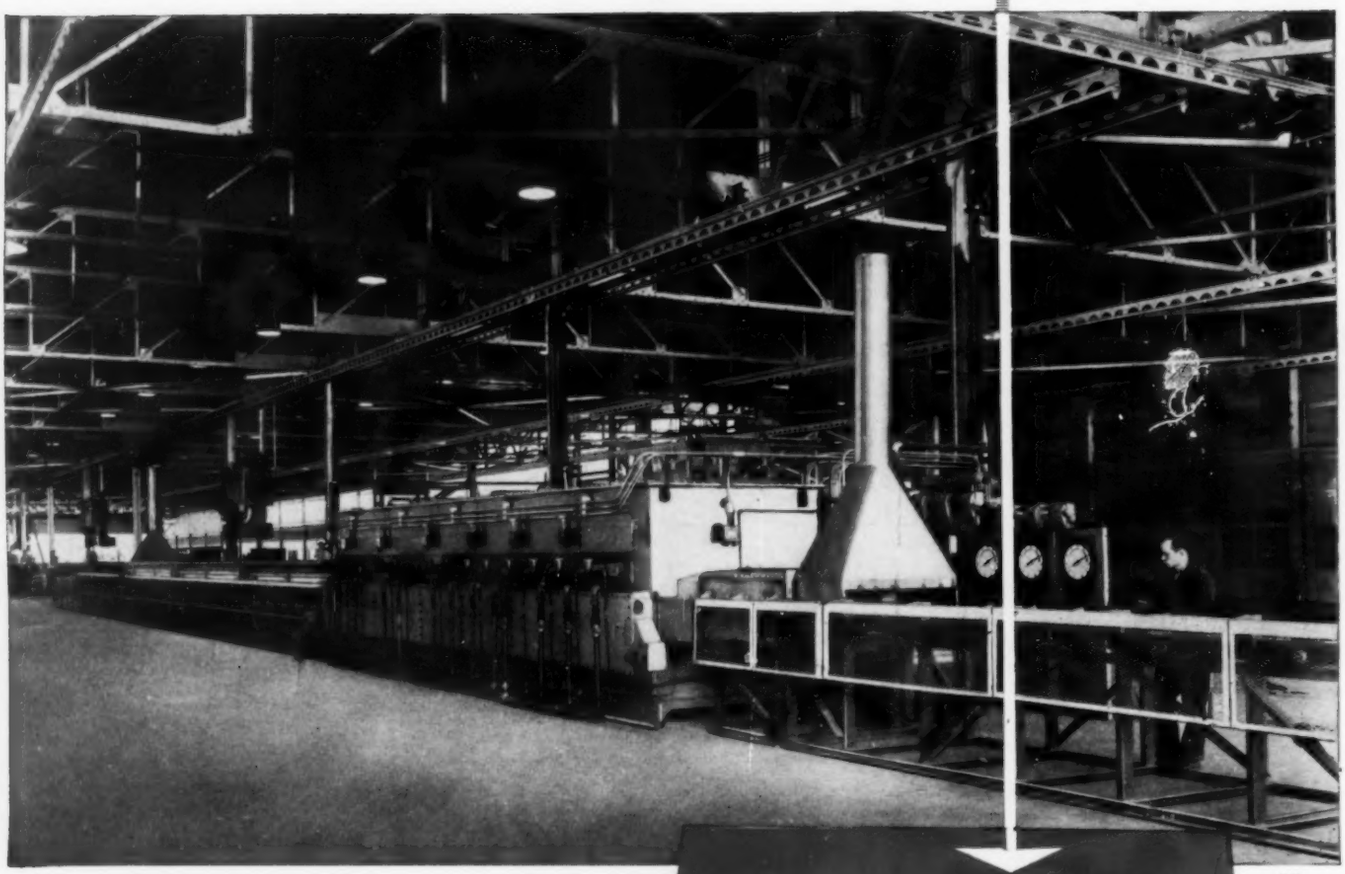

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Shown above:

Controlled Atmosphere Furnace
Radiant Tube, Gas-Fired
Capacity, 3,000# /hour
Alloy Tubing ⅛" O.D. to 2½" O.D.
Overall, 176 ft. long x 7'-6" wide

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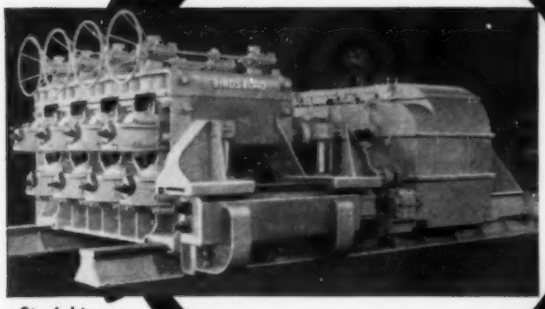
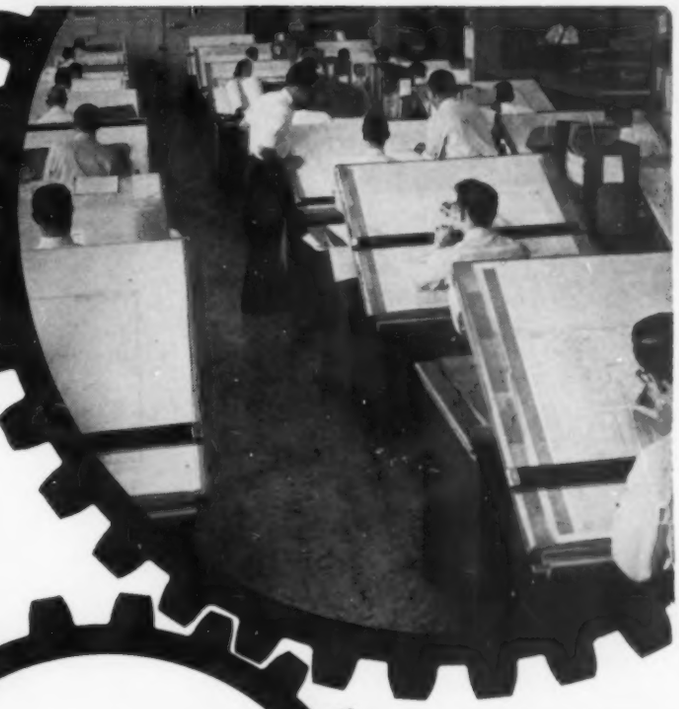
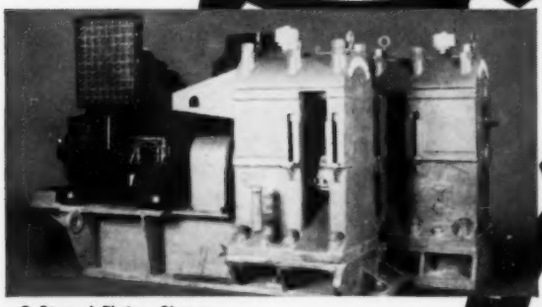
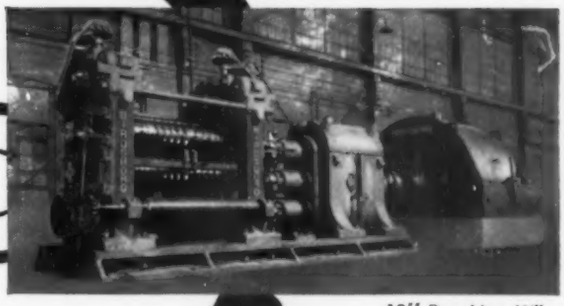


Straightener

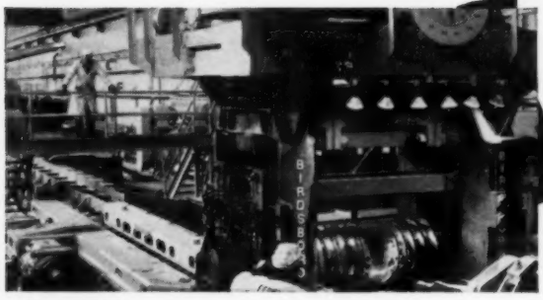




2-Strand Flying Shears



18" Roughing Mill



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• From design, to building, to installation of a single unit or a complete mill . . . BIRDSBORO'S experience in providing "customized" mill machinery has paid off in higher and higher productivity. Blooming mills, merchant and rod mills and auxiliary equipment bearing the BIRDSBORO name are performing exacting jobs in plants throughout the world. BIRDSBORO'S entire staff is geared to solve difficult problems, either on the drawing board or in the plant. Call on BIRDSBORO when you need help.

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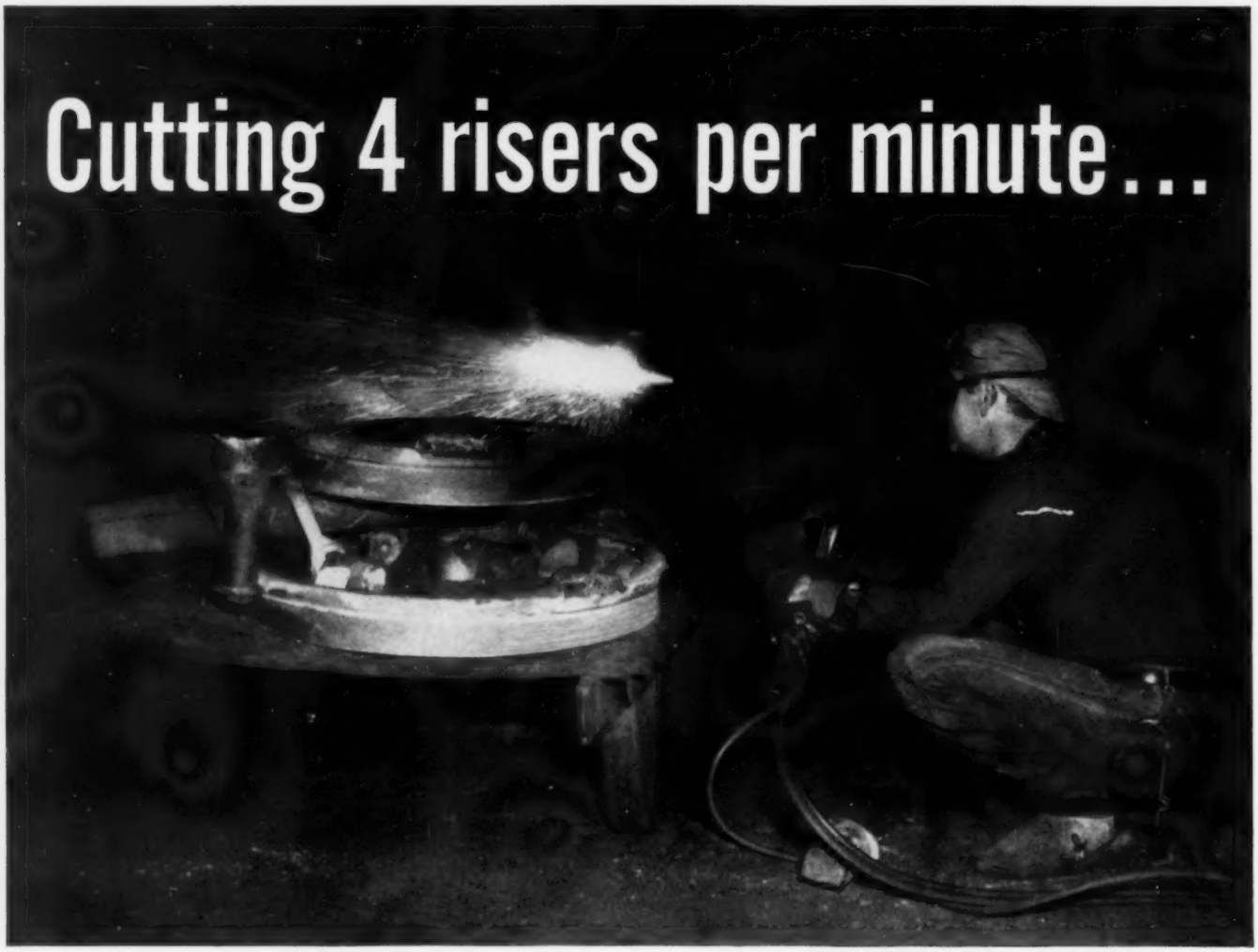
Cutting 4 risers per minute...



Lightweight and easy to handle, this OXWELD powder-cutting blowpipe makes fast work of risers.

Powder-Cutting speeds removal operations 300%

Removing risers from stainless steel castings need no longer be costly and time consuming. Pictured above is a typical powder-cutting operation at the Ohio Steel Foundry Company, Springfield, Ohio. Here, 2 by 4 inch thick stainless steel risers are removed by powder-cutting in only 15 seconds. By methods previously used, this operation took up to four times longer.

In the powder-cutting process metal powder is automatically injected into an oxygen flame to increase the flame's heat and severing action speed. The powder process is helping users gain new efficiency and speed in the removal of gates and risers, sand incrustations, and casting defects.

The powder-cutting blowpipe used in this operation, an OXWELD AC-4, is designed for hand cutting of oxidation resistant metals such as stainless steel, chrome alloys, and cast iron. Heavier apparatus is also available for manual and mechanized operations.

Increase your production and profit—call your local LINDE representative, or write for illustrated literature on LINDE's modern processes. Start saving now, do it today.

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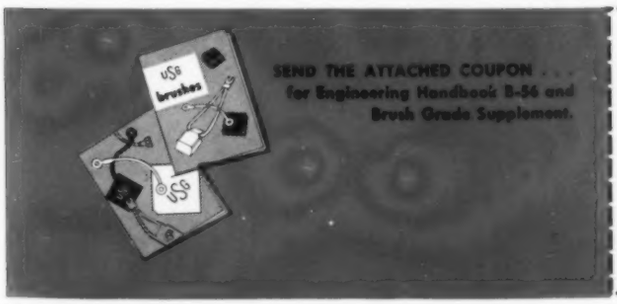

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THE UNITED STATES GRAPHITE COMPANY
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HENRY CORT *made a vital and far-reaching contribution to the steel industry when he patented his rolling process in England, in 1783. Before Cort designed and built a practical rolling mill, tilting hammers had been used to produce iron bars. This laborious process produced only about one ton of bars in 12 hours. Cort first shingled his iron into half blooms at welding temperature, then reheated and passed the hot slabs through grooved rollers of his own design. In this way he was able to produce no less than 15 tons of bars in a 12 hour period.*

While not the first to attempt rolling, Henry Cort's successful process justly earned him the title "father of the rolling mill."

Great Names in Steel Making #IV

Henry Cort's rolling mill followed a pattern as old as steel making. Whenever the need has become great enough, the right men have always developed the proper process or product to meet it.

In the modern field of industrial lubrication one thinks of such developments as the "E. P." lubricants which made today's high speed rolling mills practicable, of "Palmoshield" which freed America from dependence on imported palm oil, and of the wire drawing and cable lubricants which Ironsides engineers have originated in answer to compelling needs.

Keeping pace with 64 years of progress in steel rolling has made Ironsides' "Gear Shield" synonymous with satisfactory roll neck lubrication. So much so, that others frequently refer to their lubricants as "gear shields," even though Gear Shield is the exclusive trade mark of The Ironsides Company.

That steel men recognize this contribution is evidenced by the fact that nearly every major steel producer uses "Gear Shield" lubricants.

Today's rolling mills, so far advanced beyond Henry Cort's pioneer process, demand equally high standards in lubricants. Ironsides engineers work closely with superintendents, lubrication engineers and rollers on problems of temperature, pressure, pumpability and water repellency. Ingenuity and research are put to work until a completely satisfactory answer is found. For example, Ironsides roller bearing Shield, developed to meet the need for an extreme pressure lubricant, has load-bearing capacity in excess of bearing manufacturers' standards, and carries the approval of leading bearing makers as a result.

Ironsides engineers are prepared to "custom tailor" lubricants for the specific conditions and preferences of the individual mill. We will supply these specialized lubricants in any quantity from pail to tank car.

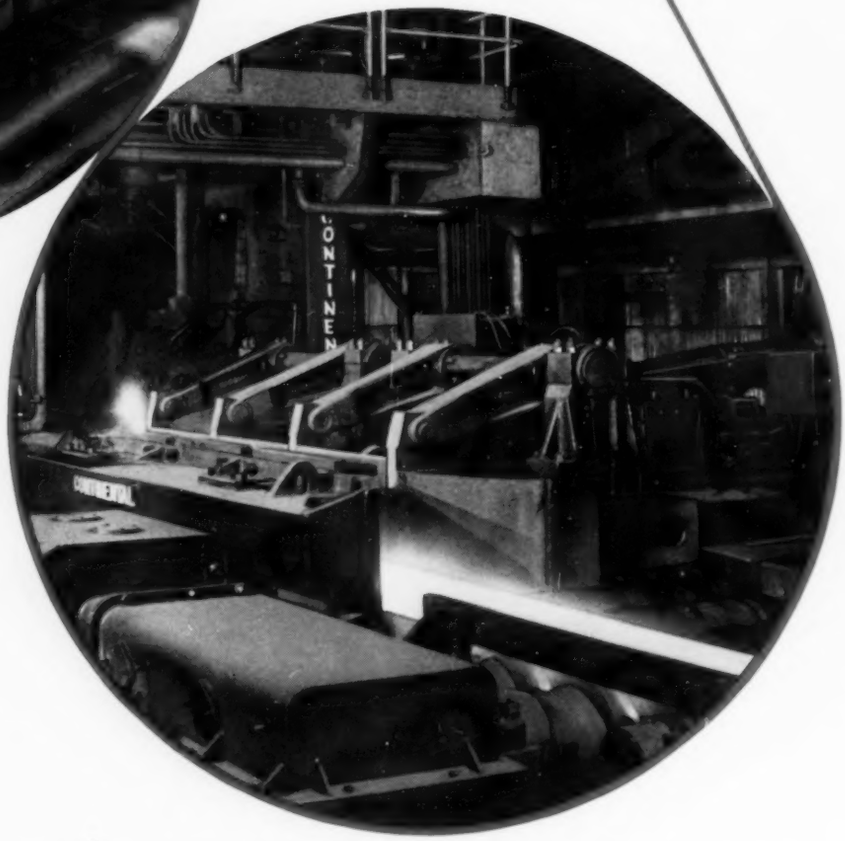
If you have a problem, our engineers would like to help you lick it. Their experience is at your service, without obligation. Address, or phone, The Ironsides Company, Columbus 16, Ohio.

By the makers of Palmoshield
"the palm tree that grows in Ohio"

Jos. Margulies.

Hyatt's new production methods here . . .

mean smoother production for you here!



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Today we're investing a lot of time, engineering talent and dollars in ultra-modern, electronically-controlled production and testing equipment. It assures a new standard of quality—*electronic precision*—in every new HYATT Hy-Roll Bearing. It means smoother running, longer service and significant savings for you.

By standardizing on new HYATT Hy-Rolls on your ingot and charging cars—main, approach and runout tables—feed rollers and lineshafting—you can be sure of *even finer* bearing performance than HYATTS have been famed for in the past! Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

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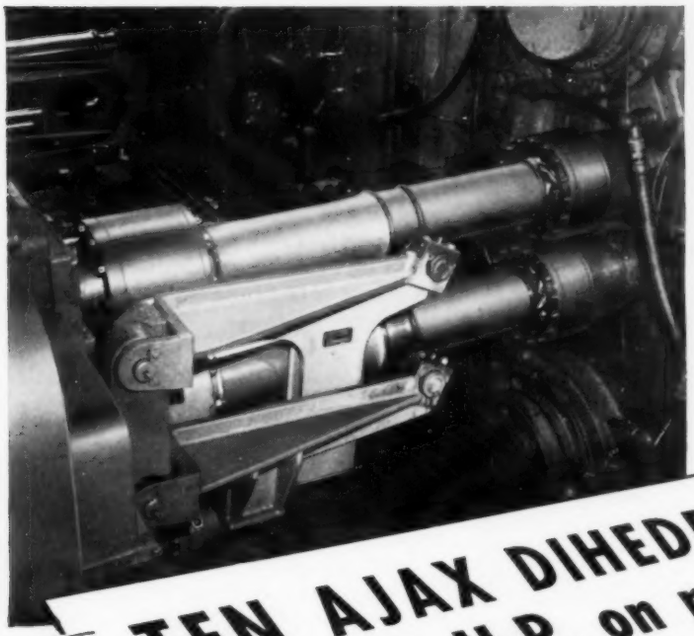
HYATT HY-ROLL BEARINGS FOR STEEL INDUSTRY



TEN AJAX DIHEDRAL COUPLINGS deliver 25,000 H.P. on new U E & F mill at Weirton

Close-up shows two of five pairs of Ajax Dihedral Spindle Couplings driving 23" and 56" x 52" 4 high 5 stand tandem cold mill built by United Engineering & Foundry Co. for Weirton Steel Co., a Division of National Steel Corporation.

▶ The critical eyes of steel men are focused on the design, performance and output of every new mill and all its components. This new 4 high, 5 stand tandem cold mill, designed for speeds up to 7200 fpm, was built by United Engineering and Foundry Co. for the Weirton Steel Co., a Division of National Steel Corporation.

It is turning out sheet of high quality finish and maintaining close gauge tolerance.

Power is transmitted from drive stands to rolls by 10 Ajax Dihedral Spindle Couplings handling 2500 H. P. each. The uniform angular velocity of Ajax Dihedral Spindle Couplings is an important factor in producing smooth finish, uniform thickness and long roll life.

Ajax Dihedral Spindle Couplings are in operation in America's foremost steel mills. They have been proved and approved by every test of time and service. Whether you are designing, specifying, building, using or modernizing mills, it will pay you to get the facts on Ajax Dihedral Spindle Couplings. Write for Bulletin No. 58.

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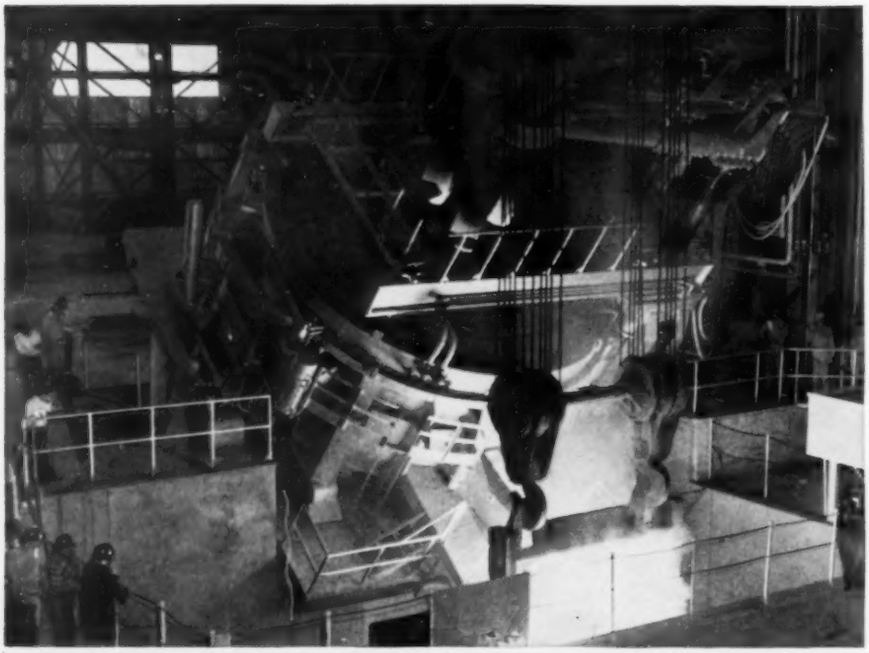
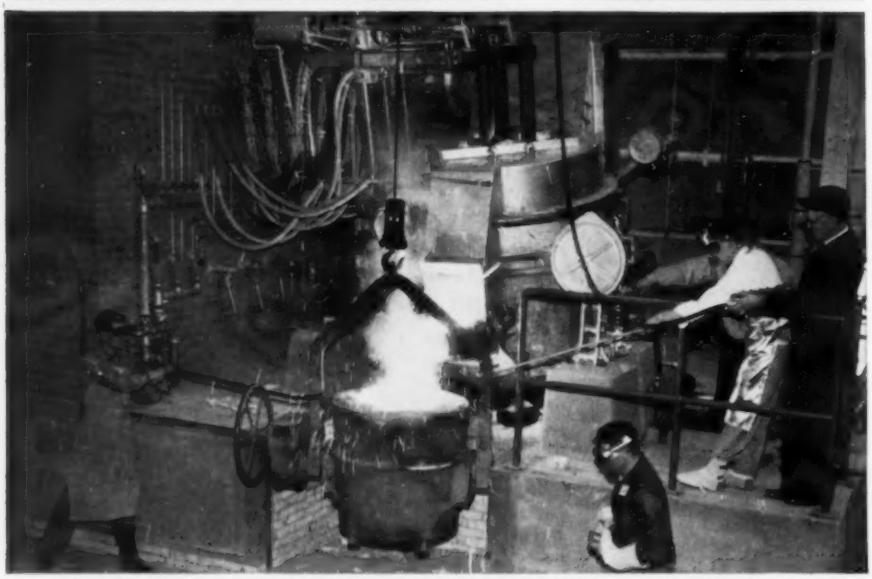
evolutionary

is the word that best describes LECTROMELT* FURNACES





● Lectromelt's revolutionary announcements were made years ago, when these developments were first introduced by Lectromelt to the metallurgical industry:

Top charging for smooth, fast turnaround in electric furnace operation. There's less downtime between heats and less heat loss. Linings and the electrodes last longer.

Power input boosted tremendously, doubling the day's output. Lectromelt construction was heavied up, larger transformers and leads provided, more efficient cooling added.

Micro-accurate electrode control was combined with counterbalanced arms, greatly increasing the exactness to which analyses could be held. Supervisory labor was thus made much less burdensome.

Why label as revolutionary the things that have long been standard on Lectromelt Furnaces? The same bold thinking—evolutionary thinking—has been constantly applied to Lectromelt Furnaces and Equipment to maintain the leadership established many years ago.

Catalog 9-B describes Lectromelt Furnaces. For a copy, write Lectromelt Furnace Company, 310 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

On research and on production, Lectromelt Furnaces provide the precision of control so necessary to the steelmaker.

Manufactured in . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa . . . JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF

WHEN YOU MELT... *Lectromelt*

Wide Flange Beam Rolling at Inland Steel Co.

The structural mill at Inland Steel was converted to roll both wide flange and conventional sections . . . . mill can now roll wide flange beams from 8 × 5¼ in. to 24 × 9 in. . . . . rolling scheme requires interchanging housings to permit alternate rolling of wide flange and conventional sections . . . . quality of sections has been excellent . . . . rolling rates of 778 tons per turn on 10 × 5¾-in. section have been attained.

▲ INLAND Steel Company decided to undertake the production of wide flange beams in June of 1954. Construction was started almost immediately and the first beams were rolled in September of 1955, about 14 months after the start of construction.

The rolling scheme required the placement of auxiliary mills into the existing 28-in. structural mill arrangement. All mill housings had to be movable so that conventional products or wide flange beams could be produced as desired. Suitably located housing shoe plates were installed. Drive motors for the three added mills together with motor-generator sets and related equipment were installed in a new motor room. Accessory equipment, such as saws and stampers, were relocated so as to suit and allow runout for the new sections. The mill building was strengthened, and a 175-ton overhead crane provided to transport the heavy 44-in. mill equipment to and from the operating and make-up positions. The entire project was designed so that wide flange beams as well as all sections traditionally produced on this mill would be continued. These items include all standard structural sections, sheet piling, Zee sills, rails, tie plates, specialties, bars and billets. There is probably no more widely diversified product produced on a structural mill.

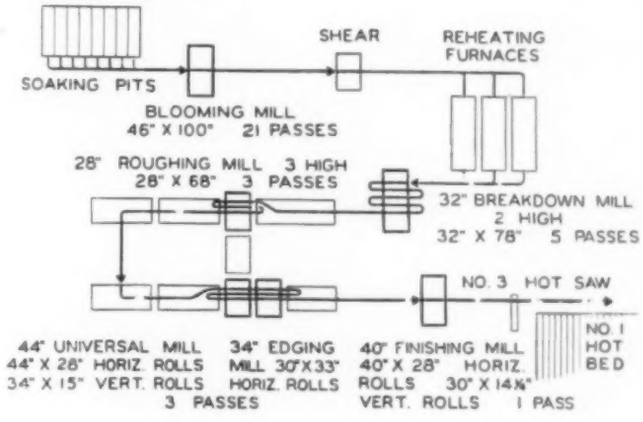
Figure 1 is a diagram of the product flow and illustrates the manner in which the beam mill housings are placed in the structural mill arrangement. In essence, the normal 28-in. mill intermediate and finishing housings are removed and stored at make-up location. The 44-in. universal beam mill is placed in the normal structural finishing mill position and the supplementary 34-in. edger is placed in tandem with it. The universal 40-in. finisher is placed in operating position 200 ft downstream from the 44—34-in. mills. With the housing arranged as described, the mill is ready to roll wide flange beams. The line in Figure 1 traces the product flow.

By
W. E. DITTRICH,
Superintendent, Plant No. 2 Mills,
Inland Steel Co.,
East Chicago, Ind.

The rolling starts with 27⅜-in. sq x 90-in. ingots weighing approximately eight tons. These are bloomed on a two-high, reversing 46 x 100-in. high-lift blooming mill driven by a 6500-hp, 50/120-rpm, 600-volt, d-c double-armature reversing mill motor having rotating regulator control. Screws are 16 in. in diam and have a 2-in. pitch.

This mill is equipped with hydraulic roll balance and

Figure 1—Sketch shows product flow when rolling wide flange beams.



has babbitt and bronze bearings with automatic lubrication. The mill has sideguards and manipulators on both the entering and the delivering sides. The auxiliary drives, tables, screwdown and sideguards have variable voltage control. Lubrication on auxiliaries is automatic circulating oil for gears, and automatic greasing for bearings. Mill tables are equipped with anti-friction bearings. This mill was placed in operation in 1953.

The ingot is reduced to rectangular blooms for all beam sizes through 14 x 6¾ in. For larger beam sizes, shaping in the blooming mill is required. Approximately 21 passes are used to reduce the ingot to a bloom or bloom shape.

The bar is cropped and sheared to required length with a 1500-ton blooming mill shear. This machine has a 21-in. stroke and is capable of shearing 600 sq in. of cross-section. This is an electric, quick-start-and-stop shear, powered with two 500-hp, 375/750-rpm, 460-volt, d-c motors, having rotating regulator controls. This shear, mill tables, transfers, pilers, etc., are all new, having been installed during 1955.

The blooms or shapes pass on to reheating furnaces to be brought to rolling temperature for the beam mill. The furnaces are continuous three-stage, gas and/or oil-fired furnaces, approximately 55 ft long and 18 ft wide, inside dimensions. The furnaces have a rated capacity of 50 tons per hr each on heating hot charged steel. Ordinarily two of the three furnaces are in operation.

After reheating, the bloom is further reduced at a 32 x 78-in., two-high, reversing roughing mill. Roll screws are 9 in. in diam and 1½ in. pitch. The mill has hydraulic roll balance, sideguards and manipulators on both the entering and delivering sides. The sideguards are driven by two 100-hp, d-c mill motors with variable

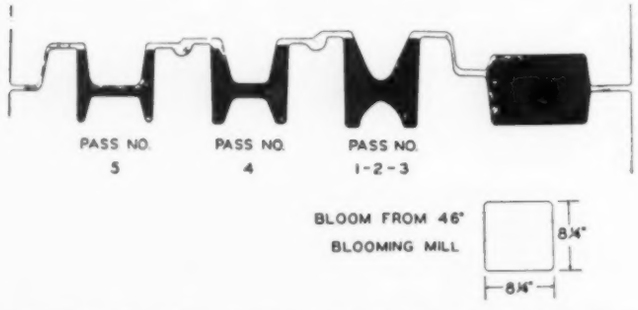


Figure 2—Profile shows passes for rolling 8 x 5¼-in. wide flange beams on a 32-in. roughing mill.

voltage control. All other accessories have constant voltage control. The mill is driven through a 32-in. two-high, pinion stand by a 3200-hp, 50/120-rpm, 600-volt, d-c reversing motor having magnetic contactor control. The main mill bearings are babbitt with bronze inserts and are automatically lubricated. Table rolls have sleeve bearings and automatic lubrication. Rolls are changed by removing the housing cap. About 50 minutes is required for the roll change.

Figure 2 gives the profile of passes at the 32-in. roughing mill for the 8 x 5¼-in. wide flange beam. An 8¼ x 8¼-in. bloom is used for producing this section. Five passes in all are made at the 32-in. mill: three in the No. 1 groove, one in the No. 2 groove, and one in the

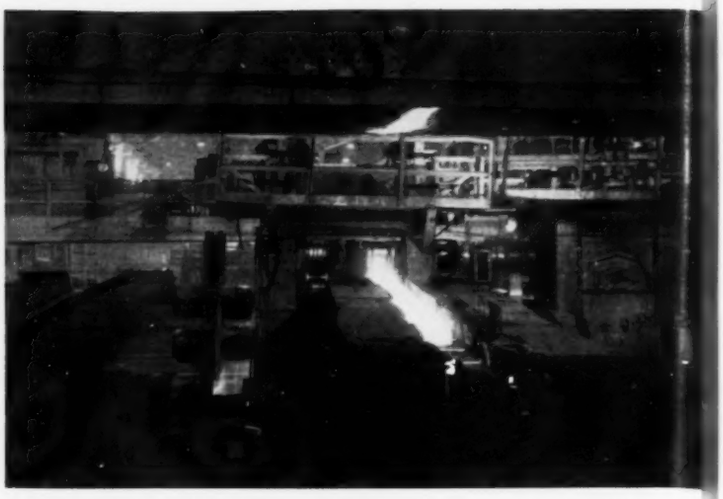


Figure 3—The 28-in. roughing stand has a 3-high mill with rolls of 68-in. body length.

No. 3 groove. The bar is turned 180 degrees between passes in order to maintain symmetry of section. Flanges are worked in live and dead flange grooves alternately. It was necessary to improve the manipulation on the original mill so that the bar could be turned on either side. The partially shaped bar passes on to the 28-in. roughing mill for further reduction.

Figure 3 shows the 28-in. mill roughing stand. This is a three-high mill with rolls of 68-in. body length and 17-in. neck diameter. It is driven through a three-high, 28-in. pitch pinion stand connected to the rolls by spindles and coupling boxes. Both babbitt and fabric roll bearings are used. Necks and bearings are lubricated with hand packed grease boxes. The mill has manually-operated top and bottom screws. Middle roll position is fixed. The top roll position is regulated by liners between the middle roll rider bearing and top roll carrier bearing. The top roll is held fixed by the head screws. This mill is driven by a 3200-hp, 50/120-rpm, 600-volt, d-c reversing mill motor having magnetic contactor

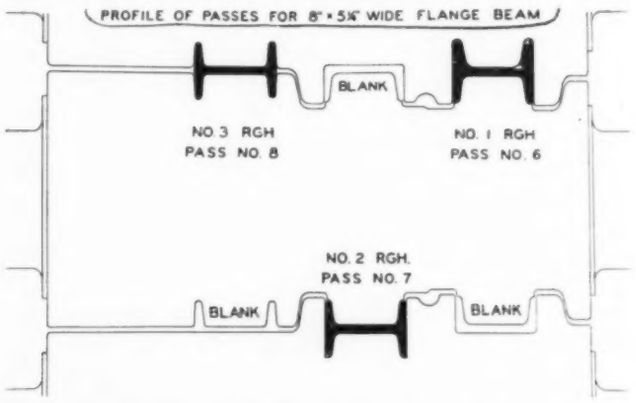


Figure 4—Profile shows passes for rolling 8 x 5¼-in. wide flange beams on 28-in. roughing mill.

control. The mill is capable of reversing but is normally operated in one direction.

Figure 4 shows the pass schedule and profiles at the 28-in. roughing mill. This is a conventional three-high, 28-in. roughing mill, and continues the rolling method used at the 32-in. mill except for pass three in which all flanges are closed. This imparts complete symmetry to the bar, if prior reductions are properly balanced. The

proper relation of flange to web must be achieved on leaving this pass. This relationship is critical since the elongation of flanges and web in the universal mill must be approximately equal. Lack of symmetry of the shape results in uneven flange lengths or off-centered webs.

Figure 5 is an isometric diagram of a bar being rolled through a closed pass and further illustrates the type of rolling in the 28-in. roughing mill.

The traveling tilting tables and trailer tables which normally serve the conventional structural mill are used to handle the bars from pass to pass, and from housing to housing in the following manner. Referring again to Figure 1; the No. 1 traveling table receives the bar from the 32-in. roughing mill, elevates it to the No. 1 pass, and enters the bar into the mill which is received on the back side by the No. 3 traveling tilting table which in turn enters the bar in the bottom or No. 2 pass. It is

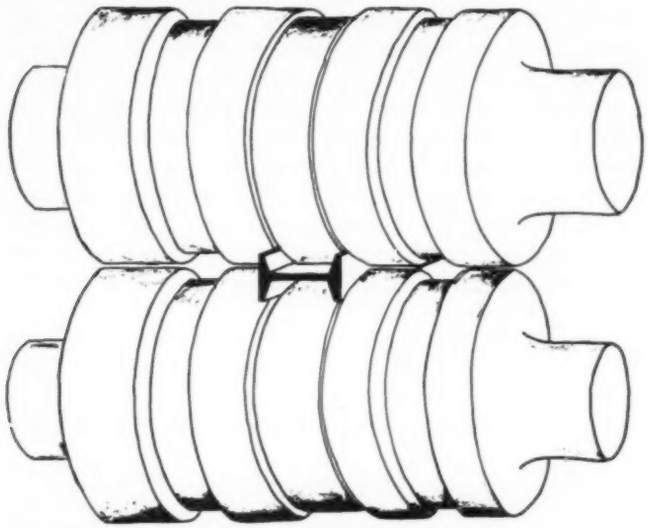


Figure 5—Closed passes are used when rolling on 28-in. mill.

again received by No. 1 table, which re-enters it in the final or No. 3 pass of the 28-in. mill. It is again received by No. 3 table and passed on to the trailer table which transports the bar to position in line with No. 4 table and the 44-in. universal mill. The bar is then entered into the beam mill. The No. 3 trailer returns to its normal operating position behind the roughing mill, while the No. 4 trailer table takes its position in line with the No. 4 traveling table into the 44-in. beam mill. No. 5 table is positioned between the 34-in. edging mill and the mill runout tables to receive the bar from the 34-in. edging mill and transport it as necessary. Normally three back and forth passes are used in the beam mill, as indicated in Figure 1. After three passes in the 44—34-in. mills, the bar passes on some 200 ft where it enters the 40-in. universal finishing mill for the final pass.

Traveling table roll drives are equipped with variable voltage control. The bridge and tilt drives have constant voltage control.

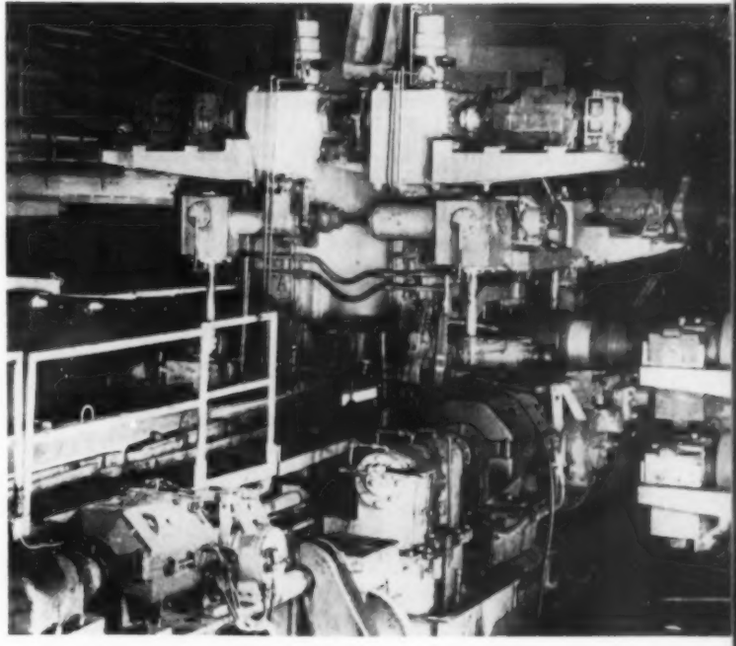
Figure 6 shows the 44-in. universal mill. This is a two-high, 44 x 28-in. reversing mill with 34 x 15-in. double-taper, faced idling vertical rolls. The axes of both horizontal and vertical rolls lie in the same vertical plane. The horizontal roll bearings are babbit with bronze floats, and are automatically lubricated. The vertical rolls have anti-friction bearings and are not driven. Both horizontal and vertical rolls are held against the screws by 600 psi hydraulic roll balance. The 44-in. universal mill is driven through a 42-in. two-high, pinion stand, driven by a 7000-hp, 80/160-rpm, 700-volt, d-c double-armature, reversing motor having rotating regulator control.

The 44-in. mill has two separate screwdown systems, one positioning the vertical rolls and the other positioning both the top and bottom horizontal rolls. The horizontal roll screws are driven by two 35-hp, d-c motors, one for each side of the screw system. It is possible to separate the screws on either side of the mill by a clutch mechanism, wherein each side may be operated independently. It is further possible to separate the top and bottom screws in the drive so that the top screw may be operated independently from the bottom on either side. The vertical roll screws are driven by two 25-hp, d-c mill motors; one on each side of the screw system. These screws may also be independently operated by engaging or disengaging a clutch. The clutches are of flexible cutout coupling design and are air operated from hand valves located on the housing face. The clutches are used only in setting up and adjusting the rolls. The motors in each system are mechanically connected during normal rolling operation. The horizontal roll screws are 10 in. in diam and are 1-in. pitch. The vertical screws are $7\frac{1}{2}$ in. in diam and of 1-in. pitch.

The 42-in. two-high, pinion stand housing is installed to drive the 44-in. mill and is replaced with three-high, 30-in. pinions for conventional rolling. The pinion housings are held down by hydraulic clamps. The spindles, connecting the pinions to the rolls, are supported by spindle carrier bars which are fastened to the pinion housings so that the pinion housing and spindles may be transported as a unit. The spindles are connected to the rolls by slip type couplings and are held in place by stretcher blocks and bands. All pinions, whether for the conventional mills or for the beam mills, have a circulating oil system.

The distance between housing halves is constant for

Figure 6—The universal beam mill is a 2-high, 44 x 28-in. reversing mill.



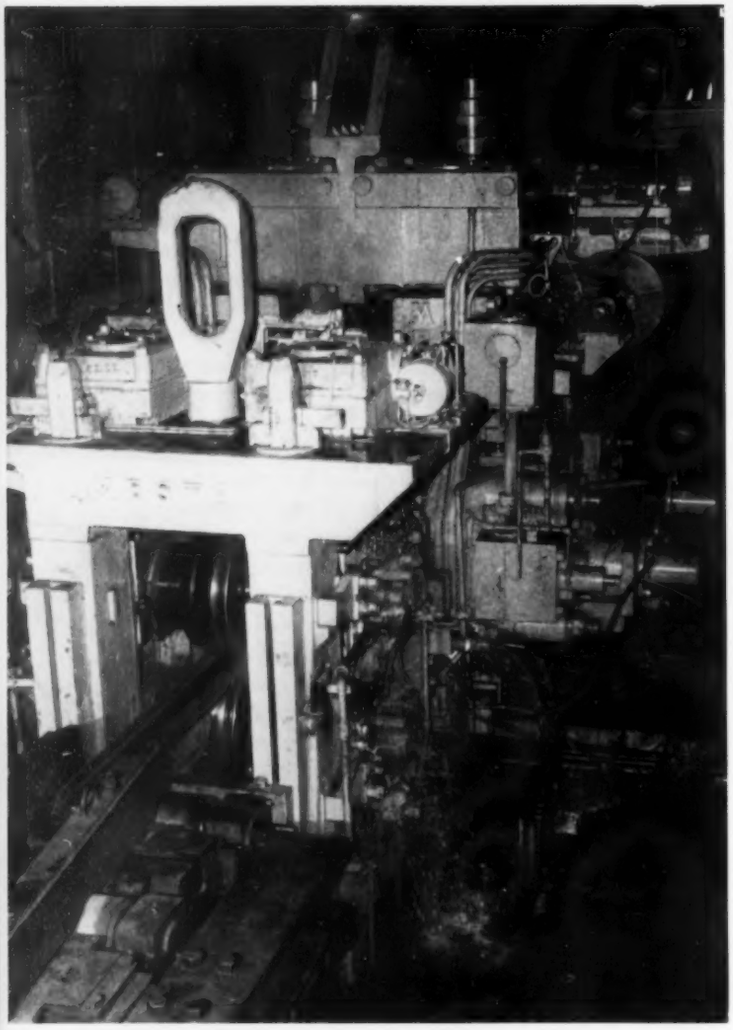


Figure 7—A supplementary edging mill is used to control flange width.

all sections, and the overall length of rolls used in this mill is the same for all sections. The housing halves are held in position by four 6-in. diam tie bolts.

A supplementary edging mill is required in this operation to control flange width. This mill is installed in tandem on 11-ft centers with the 44-in. mill. Figure 7 shows this mill. This is a 34 x 33-in. two-high, reversing mill. Roll necks are 16 in. in diam. Roll neck bearings are babbitt with bronze floats and automatically lubricated.

The bottom roll elevation is fixed, being set level with the last pass made in the 44-in. universal mill. The edger bottom roll elevation is adjustable by means of wedges manually operated by screws. The top roll is positioned by 7½-in. diam screws of ½-in. pitch, which are driven by one 25-hp, d-c mill motor. The top roll is held against the head screws by springs. Centering and leveling of the top roll is accomplished by use of a clutch separating the two screws. The mill rolls are driven through 38-in., two-high pinions which are permanently left in operating position. The edger spindles are equipped with a pullback mechanism for connecting the spindles to the rolls through universal couplings.

The mill is driven by a 1400-hp, 160/360-rpm, 700-volt, d-c, double-armature, reversing motor having rotating regulator control.

Suitable guides are provided to enter and deliver the bar to and from the universal and edging mills. The 44-in. mill top delivery guide is connected to the 34-in. top entry guide by a connecting guide. The same principle applies to the bottom guides. The width of the guides is critical and is maintained very close to the inside flange width of the bar to prevent flanges from turning down.

A pass profile diagram of the 44-in. mill is shown in Figure 8. It will be noted that the flanges in the universal mill are flared. The inner and outer faces of the flanges are parallel. The angle of flare is approximately 6 degrees. This method of rolling improves roll life and permits the rolling of parallel flanges. Flared flanges are straightened in the 40-in. universal finishing pass.

Since the centerline of the vertical rolls is fixed, the horizontal rolls must be leveled and alined to the vertical rolls. A system of screws and clutches is provided to do this, as previously described. The success of the section is dependent on proper alinement of rolls, one to another, as the rolling scheme requires symmetrical and proportional reduction from pass to pass. Lack of symmetry, resulting from improper roll alinement either in the 28-in. mill or the universal 44-in. mill, will result in off-center webs or in variable flange thickness or widths. Precise roll settings are essential to acceptable section and efficient operation. It will be noted that the flanges are not confined and are allowed to develop freely in the 44-in. mill.

As shown in Figure 9, the edging mill functions only to control the flange width by edging the flange tips. There is no web work in the edger.

Figure 10 illustrates the method of rolling in the 44-

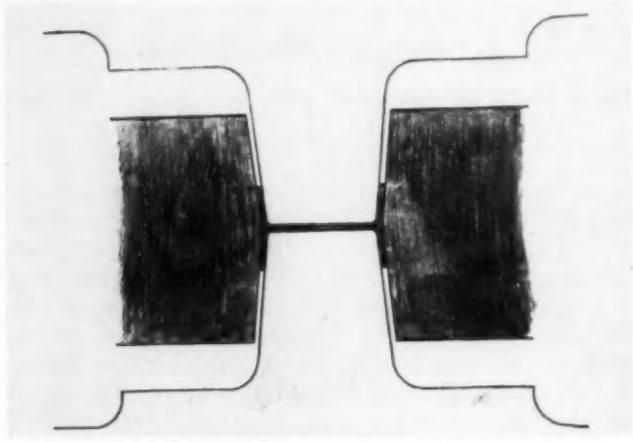
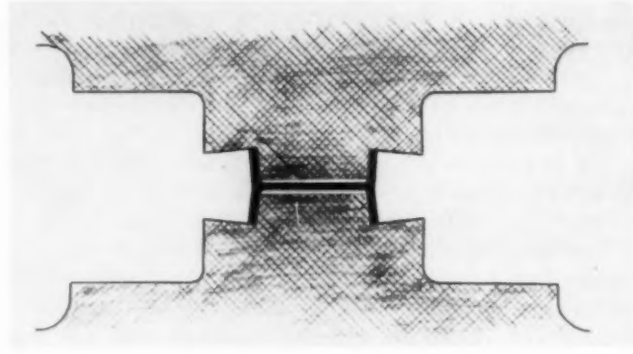


Figure 8—Flanges in the universal mill are flared.

Figure 9—Edging mill controls flange width by edging the flange tips.



in. universal and the 34-in. supplementary edging mills.

To accomplish uniform and symmetrical reduction in the universal mill, the screw system is arranged so that all rolls close in uniformly from pass to pass in predetermined and preset drafts. In the edger, the level of the bottom roll is fixed and only the top roll opens or closes.

The bar is elongated approximately three times in the three passes in the 44—34-in. mills. The rapidity and ease with which elongation is developed in this mill is striking. For the 8 x 5¼-in. section, the bloom, 16-ft long, is elongated to 180 ft in 12 passes.

The 44 and 34-in. mills are operated in tandem by one operator. The controls are similar to those used at a blooming mill. The direction and speed of the horizontal rolls are controlled with a foot-operated master switch. Speed and direction of the table rolls are controlled by a handmaster with the right hand, while the screws are set with a pushbutton by the left hand.

The 44—34-in. mills are currently being operated with a bar speed of about 900 fpm. A maximum speed of 1800 fpm is possible.

A modern preset screwdown controller is provided wherein the draft for all rolls, three systems, is set by the mill roller on schedule boards. Figure 11 shows the pass schedule boards. The screws are automatically set from pass to pass by pressing a button. The settings are repeated countless times without variance from

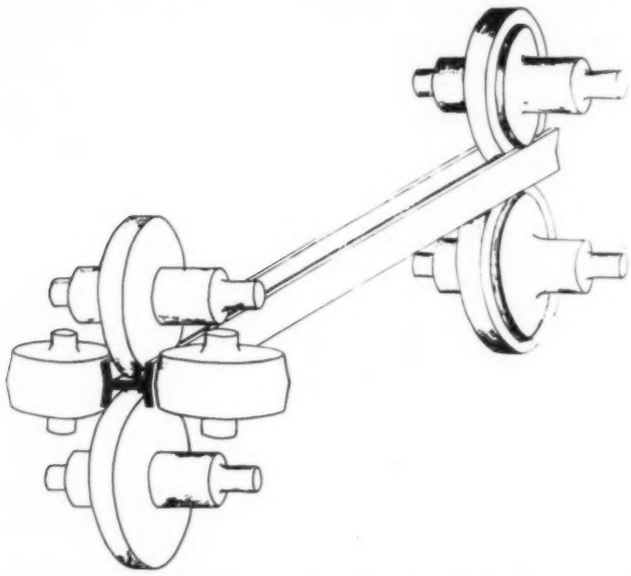


Figure 10—Sketch shows how universal and edging mill rolling is combined.

pass to pass and from bar to bar. Pass setting is more accurately and rapidly attained than could be done manually.

Each screwdown has two schedule panels, a main panel marked off in 0.2-in. steps and a vernier panel marked off in 0.01-in. steps. The desired roll opening for each pass is set by a slide contactor. A maximum of 11 passes may be scheduled.

The pressing of a momentary contact button moves the rolls to the exact preselected draft setting without over-shooting or inching. Each screwdown has a set of indicating lights wherein the operator may check to make sure that the setting for the proper pass has been achieved in each screw system. This is simplified so that the lights are in vertical alinement when

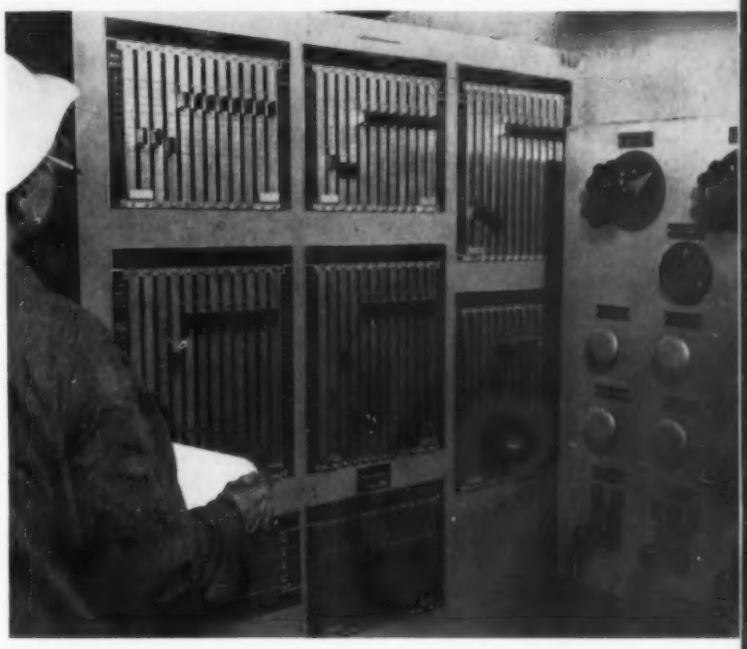


Figure 11—Draft schedule is set up on a preset control board.

all screws are set on the same pass. The three screw systems can be controlled either by the preset or by individual manual controllers. Use of the manual control may be made at any time and has priority over the automatic system, but allows for the continuance of the preset control at the next setting. This feature is helpful in coping with any unusual circumstances in drafting which may arise. Each screwdown system has an "advance one pass" button and a "return to first pass" button which may be used, should the screws get out of step during any unusual conditions. A fast "open all screws" button is also available for emergencies.

Automatic screwdown control is achieved through the use of a synchro-tie transmitter geared to the screwdown motor and a synchro-tie receiver at the control panel. A differential unit, main and vernier rheostats, a small setup motor, and a cam limit switch control the amount and direction of screw movement.

Draft indicators, one for each screwdown, are placed on the operating desk in the pulpit to indicate the exact roll opening. Draft indicators are operated by synchro-tie transmitters and receivers. In installing the 44-in. and 34-in. mills, it is necessary to connect some 11 motors. This is done by use of multi-pronged connection plugs. For convenience, the roll openings between horizontal rolls and vertical and horizontal rolls in the 44-in. mill, as well as the horizontal roll web opening in the edger, are set at 1 in. by means of a plug gage. After connecting the synchro-tie transmitters to the receivers, the draft indicators and the preset mechanism are set to 1 in. by use of adjustable couplings to match the actual roll openings. The schedule boards are now set at the predetermined required drafts, and the mills are ready for operation with automatic screwdown control.

In order to correct for the variances in speed between the universal and supplementary mills arising from changes in drafting or changes in roll diameters, a provision for speed matching is required. Lack of

proper speed matching will cause the bar to be in tension or compression between the main and the supplementary mills.

Rheostats, marked in inches of roll diameter, are provided to accomplish the speed matching required for various roll diameters. Speed matching to compensate for difference in elongation between the 44 and 34-in. mills is also required, when the bar travels from the edger into the 44-in. mill. This is accomplished by means of a draft compensating board which corrects the edger speed. The edger motor has a drooping speed characteristic which also inherently assists speed matching.

After three passes back and forth in the 44-in. mill, the bar passes on to the 40-in. universal finishing mill which is 200 ft downstream from the 44-in. mill.

Figure 12 shows the finishing mill which is a 40 x 28-in. two-high, universal mill. Roll necks are 16 in. in diam. Roll bearings are of babbitt and bronze and are automatically lubricated and hydraulically counterbalanced. The vertical rolls have anti-friction bearings and are not driven. Both horizontal and vertical roll screws are 7½ in. in diam and of ½-in. pitch. Horizontal and vertical roll screws are both manually set. The bottom roll bearings, as well as the mill housing, may be adjusted for level. The elevation may be adjusted or regulated by wedges which are moved by manually-operated screws. Wedge adjustment under the shoes to obtain suitable elevation of the pass line as related to the table rolls is required because of varying flange widths. This feature avoids the necessity for tilting tables at this point.

All of the beam mills are provided with 125-psi water for roll cooling and descaling.

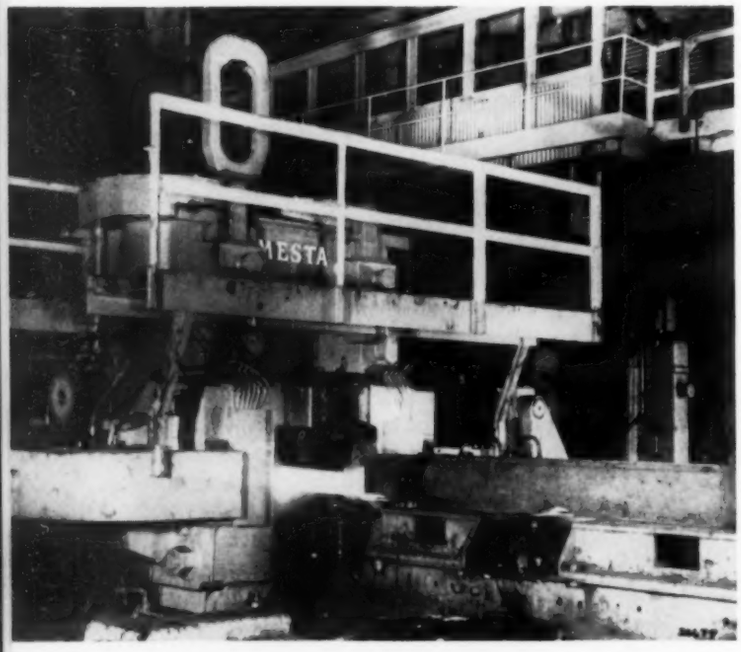
The mill is powered by a constant speed 3000-hp, 375-rpm, 2200-volt, a-c slip-ring induction motor which delivers the bar at about 600 fpm. The 40-in. finishing mill horizontal rolls are driven through a 38-in., two-high, pinion stand and a six to one reduction gear unit connected to the motor. The pinions remain in the operating position at all times. The finishing mill is removed when rolling conventional sections. The two spindles are supported in a spindle carrier and are connected to the roll wobblers by a coupling box held in position by blocks and stretcher bands. A man is stationed at this mill to control the entering of the bar into the mill and to stop the mill in an emergency.

Figure 13 shows the pass profile at the finishing mill. The vertical roll face is flat as contrasted to the conical faced vertical rolls at the 44-in. mill. The finishing mill serves chiefly to straighten the flared flanges delivered from the 44 and 34-in. mills. Approximately five per cent reduction is made for final sizing in the finishing mill.

Figure 14 shows an isometric view of the rolling action in the finishing mill. Disproportionate work in the 44 or 40-in. mills results in either web or flange buckle.

After the final finishing pass, the bar proceeds to the 66-in. hot saw approximately 220 ft from the

Figure 12—Finishing mill is a 40 x 28-in., 2-high universal mill.



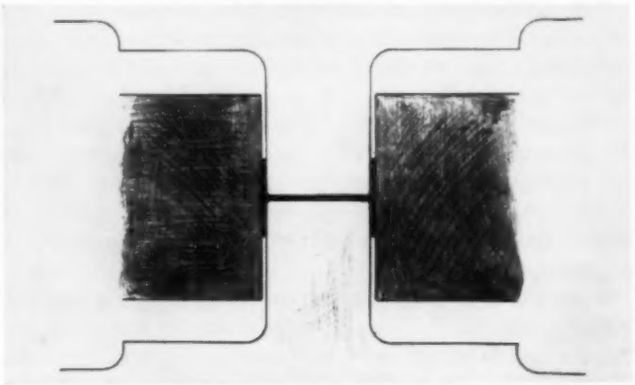


Figure 13—Profile shows passes used on 40-in. universal finishing mill.

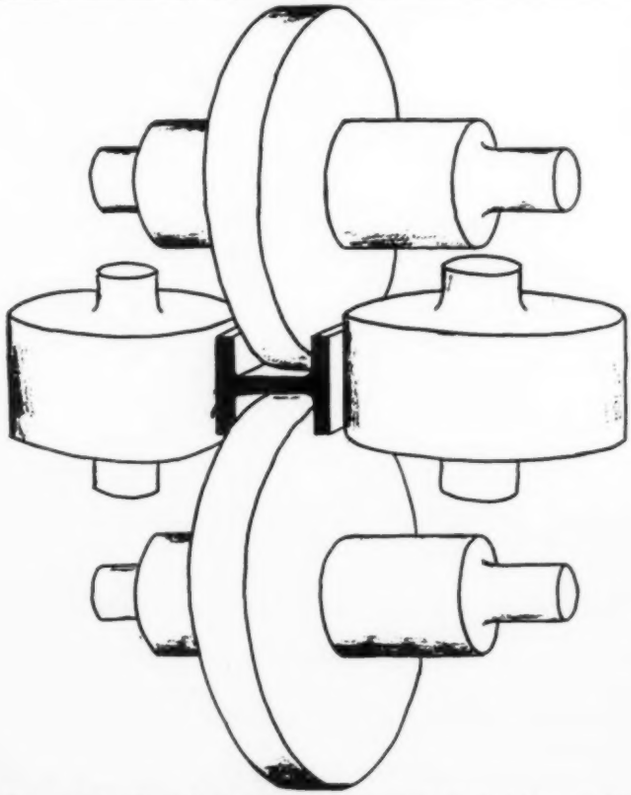


Figure 14—Sketch shows rolling action in finishing mill.

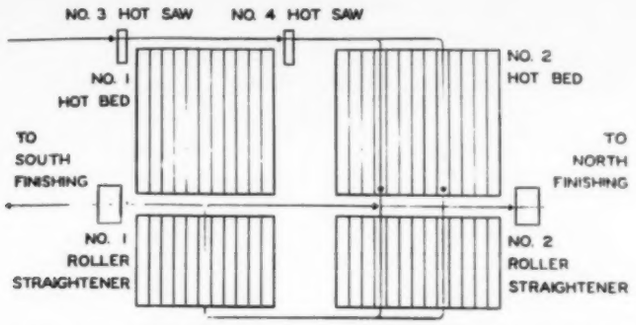


Figure 15—Hot bed allows the handling of two rows of 60-ft material.

finisher. The saw is operated at 21,900-fpm peripheral speed and is driven by a 400-hp, 375-rpm, 2200-volt motor. The traverse of the saw is operated by an 800-psi hydraulic cylinder. The rate and length of stroke are both hydraulically controlled. Hydraulic clamps secure the bar squarely and firmly during the sawing operation.

Crop disposal is accomplished by dropping the crops through an opening in the table. Crops may be diverted into boxes on either side by means of a pneumatically-operated flop gate permitting one box to be filled while the other is being dumped. Electrically operated saw stop gages are also provided.

Figure 15 shows the hot bed arrangement and the method of product handling to and from the hot beds. The hot sawed bars are pulled off onto a 135 x 150-ft hot bed which allows the handling of two rows of 60-ft material. The procedure shown is necessary to attain sufficient cooling of the bars prior to roller straightening. As seen from Figure 15, the product may be directed through either the No. 1 or the No. 2 roller straightener for final gagging, cold sawing and shipping.

The southward or No. 1 finishing section has been in existence for many years for the finishing of structural commodities. Facilities originally included an angle shear, a gag and a cold saw. This equipment has been augmented by an angle kick-off, beam turnover and a sorting, inspection and piling transfer served by a five-ton, double-trolley, 90-ft gantry crane.

New finishing facilities were provided for handling wide flange beams. A new large roller straightener, a gag, cold saw and two 90-ft span, five-ton, gantry sorting and piling cranes were installed. A total of five transfers with connecting roller lines have been provided to process the straightening, inspection, cutting and piling. Table rolls in the finishing end are 3 ft-6 in. long and 18 in. in diam with 5.1-in. drive roll necks on the drive end. Solid forged table rolls with anti-friction bearings are used. Drives are all enclosed and have splash lubrication for gears, and an automatic grease system for bearings. The transfers are rope driven and are powered by 100 to 150-hp, d-c mill type motors.

Figure 16 shows the No. 2 roller straightener. This is an eight-roll, open-ended machine designed to straighten beams through 21 x 8¼ in. The rolls of this machine have anti-friction bearings lubricated by a circulating oil system. The top four rolls are driven through a 5.65 to 1 reduction unit, powered by a 750-hp, 400/800-rpm, 600-volt, d-c reversing motor with rotating regulator control. The bottom four rolls are idling, each equipped with two screws to adjust elevation as required. Manually operated couplings are provided to separate the screws for leveling purposes. Each of the bottom four rolls may be independently elevated as desired. Each pair of screws is driven by a 10-hp mill type motor through a worm and worm wheel arrangement. All eight rolls may be independently adjusted laterally. The lateral movement of each roll is accomplished by a 2-hp motor driving a pinion meshing and adjusting nut which moves the thrust bearing cage. Vertical rolls are provided both at the entry and delivery sides of the straightener. These are electrically driven by 50-hp motors. The vertical rolls are positioned by a 2-hp motor driving a screw and a nut. The vertical rolls may be tilted by manually-operated screws. The entire straightener may be retracted by a double screw drive and a 50-hp motor. In the retracted

Figure 16—Roller straightener has eight open end rolls.

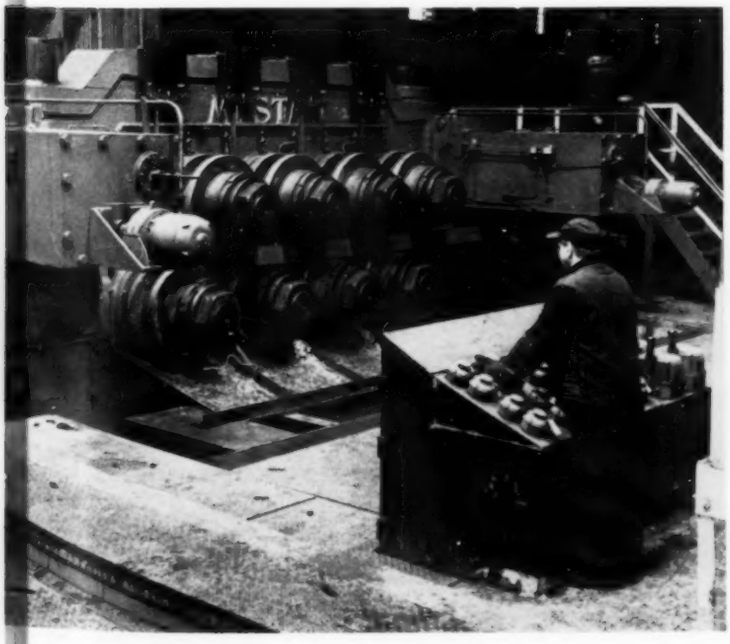


Figure 17—A gag press is used for final straightening.

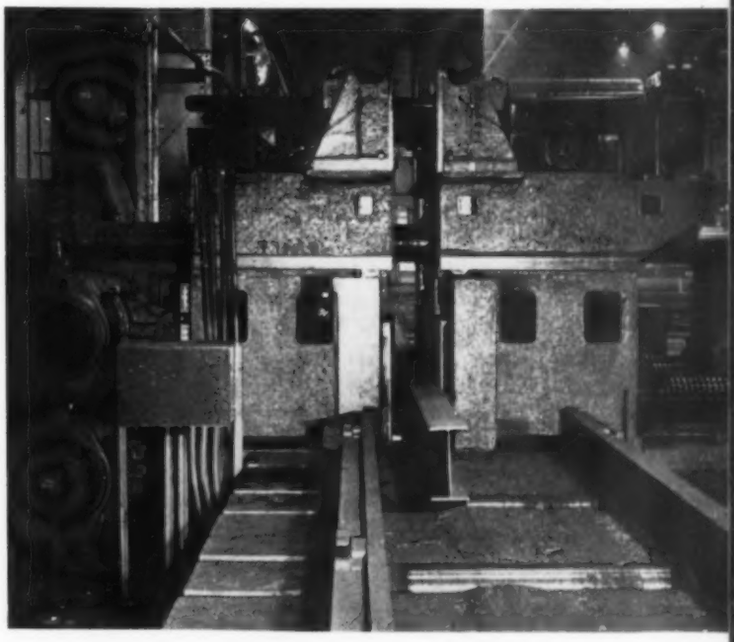


TABLE I

Sizes Produced
Wide Flange Beams

Nominal size, in.	Weight per foot, lb	Nominal size, in.	Weight per foot, lb
8 x 5¼	17 20	16 x 7	36 40 45 50
10 x 5¾	21 25 29	18 x 7½	50 55 60
12 x 6½	27 31 36	21 x 8¼	62 68 73
14 x 6¾	30 34 38	24 x 9	76 84 94

position, an electrically driven filler table replaces the straightener. Twenty-three electric motors are used in the operation of this straightener. All controls are located on an open desk near the straightener for convenient operation.

A gag press for final straightening is also provided, and Figure 17 shows this machine. This is the conventional type gag with one oscillating ram side driven by a 150-hp motor and one screw head driven by a 50-hp motor to position the frames as required to suit the section. The ram side oscillates at a rate of 35 strokes per minute, and the screw side moves at a rate of 8.6 fpm. Each side is equipped with seven anvils electrically positioned from the pulpit. The greatest spacing of anvils is 11 ft, and the shortest is 4 ft. There are two pneumatically operated manipulators, one on the entering and one on the delivering side of the machine.

The cold saw duplicates the design of the previously described hot saw. Electrically-operated cold saw gages are also provided.

The new finishing facilities are housed in a building 94 ft wide by 920 ft long; and 660 ft of this was added as part of the beam mill program. Two hundred and twenty feet was added to one end of the mill building to provide adequate raw storage area for beams awaiting finishing. An additional 220 ft was provided on the opposite end of the building to accommodate added roll storage and roll build up facilities. Six hundred feet of shipping track is located in the No. 2 finishing end for shipping purposes.

Since the rolling scheme requires an interchange of housings to permit alternate rolling of wide flange and conventional sections, a position for storing and setting up beam housings was required. Shoe plates and suitable pits to receive the beam mill housings were installed.

The 44-in. mill shoes are equipped with a screw-driven sled section for retracting or separating the two halves of the housing. A 35-hp motor is used to retract the housing.

The screwdown motors of both the 44 and the 34-in. mills may be plugged in at the make up area. Hydraulic roll balance facilities are also provided. Rolls may be assembled and set up at the build up prior to installing in operating position.

Table I shows the range of standard wide flange beams currently projected to be produced. These range from 8 x 5¼ through 24 x 9 in.

TABLE II

Sizes Produced
Wide Flange Light Beams

Nominal size, in.	Weight per foot, lb
10 x 4	15 17 19
12 x 4	16.5 19 22
Wide Flange Joists	
10 x 4	11.5
12 x 4	14

Table II shows the sizes of light beams and joists being produced. This includes both the 10 and the 12-in. sizes.

Figure 18 illustrates and compares the profiles and mechanical properties of 8-in. wide flange and 8-in. standard beams. Note that the same strength is obtained from the 8-in. wide flange beam at a saving in weight of 1.4 lb per ft. Also note the difference in flange taper.

To date all sections up to and including 21 x 8¼-in. beams have been successfully rolled. The quality of section has been excellent from a standpoint of uniformity of gage, symmetry of section and adherence to length tolerances. The operating experience has continued to improve since the initial trial rolling, at which time the second bar was produced into a salable section. The rolling operation on the 44—34-in. mills is smooth and fast when setup conditions are proper. While difficulties of setup, installation, rolling, and obtaining section have been encountered, improvement is being made. Rolling rates of 778 tons per turn on the 10 x 5¾-in. and 645 tons per turn on the 8 x 5¼ in. sections have been attained. There is every indication that the mill will measure up to expectations. It is proving to be a successful operating unit.

DISCUSSION

PRESENTED BY

EARLE A. OSGOOD, Superintendent, Structural Mills, Bethlehem Steel Co., Lackawanna, N. Y.

W. S. STOVER, Division Engineer, Mesta Machine Co., Pittsburgh, Pa.

W. E. DITTRICH, Superintendent, Plant No. 2 Mills, Inland Steel Co., East Chicago, Ind.

Earle A. Osgood: It is a pleasure to see a structural mill revamped and revised along more modern lines. We have not seen much of that in structural mills for a long time.

It seems to be a necessity that the finishing universal housing be about 200 ft out from where the old finishing housing stood, then the hot saw 200 ft beyond. Down at the finishing end, the usual layout seems to me a

handicap to both safety and production. Inland has installed three gantry-type magnet piling cranes with telescoping hoists. This is an important safety action, removing the hazards of men handling shoe hooks and tongs on free-swinging hoists.

A good many mills can and should go a lot further than this in removing handling hazards of the finished shapes.

There is a change in the original roughing mill that is interesting. That is, the top roll of the three-high mill which was carried on spring bolts from the cap is now built up solidly with carrier and rider bearings on both middle and top rolls and liners used between the roll bearings.

That means that there is no slap between middle and top rolls when diameters are larger in the rougher than the intermediate. In the spring-carrier build up, a

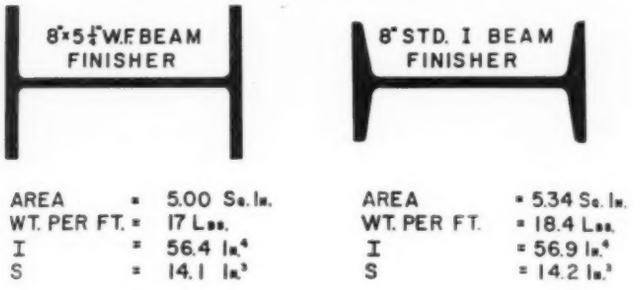


Figure 18—Sketches compare sections and properties of wide flange and standard I-beams.

load in the intermediate would cause the top rougher to pull down as far as possible into the axis line of the top pinion and the top intermediate.

The four closed flange passes in No. 3 roughing pass is interesting. Most layouts have alternately open and closed passes, top then bottom or vice versa. The four closed passes apparently are necessary to give controlled flange length ahead of the universal mill.

W. S. Stover: There are a few things on the design of this mill that may be of interest. Since this mill does not cover the full range of all sizes of beams, it was possible to make this mill much stiffer than the existing mills which roll up to 36-in. beams. This stiffness is particularly important in the various small sections which have closer tolerances.

The universal mill and finishing mill housings are on fixed centers. This differs from the previously existing mills where the housing centers were adjustable to the various widths of beams rolled. This meant that it was necessary to have a great number of mill separators of various lengths and spacers on the tie rods to accommodate the changes of the housing centers. This meant extra equipment and took valuable floor space for storage and meant that these mills left a lot to be desired in rolling small sections.

Being able to insert mills to roll wide flange beams in existing structural mill setups, certainly makes this a very flexible arrangement. It provides an incentive to management, I believe, to do a little modernization in these mills, because you are extending the range of product rolled.

It is always interesting to see how the construction and operating men in the field can get a mill like this running, where you are trying to keep your other equipment in operation. To put in a mill like this in two weeks with only two weeks shutdown is certainly remarkable, and I believe that it was done without any serious accidents.

At the outset, it was planned that a lot of the minor revisions to the existing equipment would be done on normal downtime, for when this program started the structural mill was not running too heavily. As it always happens, when the equipment was delivered, production had increased considerably and a lot of downtime was not available. They did it anyhow.

One question that may be of interest to some of the others, is how long does it take to change stands from rolling standard sections to rolling wide flange sections and vice versa?

W. E. Dittrich: We are not changing rolls as fast as we would like to, but we have changed in an hour and forty-five minutes. Normally it would take us now around two hours to change from one section to another.

Member: I would like to know what the yield is from ingot to bloom and from bloom to finish.

W. E. Dittrich: We are aiming for 90 per cent yield from ingot to bloom and 92 per cent to 93 per cent from bloom to finish bar.

1957 AISE SPRING CONFERENCE

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. . . . back in 1907, the AISE was founded to further the electrification of the steel industry . . . . its success can be seen from what has been accomplished so far in present-day mills in high production speeds, more accurate control, labor savings and production economies . . . . the next fifty years should see as much, if not more, progress . . . .

STEEL MILL DRIVES— Past, Present and Future

By

R. H. WRIGHT,

Steel Mill Engineer, Metal Working Section,

Industry Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

▲ IN searching for the most outstanding wonders of the present age, at least one group of investigators has decided that steel should head the list. Most certainly steel was not chosen because it is a new material. Obviously steel was chosen because steel-makers and steel fabricators have developed the basic materials and techniques for most of the recent spectacular advances in other lines. All of today's common scientific devices, ranging from high pressure vessels, reactors and jet engines to radar and calculating machines, depend upon some special grade of steel for their success.

For a process as old as that of making steel, it is difficult to say just when the most pronounced advance was made. Blast furnaces in some form or other have been known and used for hundreds, perhaps thousands of years. Crucible steel, using the product of these crude furnaces, was made long before the Middle Ages. Then the art was lost for a time, and the process was rediscovered about two hundred years ago. The bessemer process was patented in this country in 1856 and open hearth furnaces were operating in 1870. Many men now living can remember seeing the puddler at work making wrought iron by a still older process. Who can say that any of these steps are not as important as anything we have done in recent years? However, it seems fair to say that the present phase of advance began when electric power became a factor in the industry.

Electricity came into use in the American steel industry about fifty years ago. In October of 1905, two 1500-hp, d-c motors went into operation on a light rail mill. In the same year, two 1800-hp, a-c drives were purchased for the same purpose. The first reversing equipment started operation in 1907. During this same period, construction work was under way on the Gary Works which was designed to operate almost entirely on electric power; and on April 5, 1906, the Halcomb Steel Company started the first American electric arc furnace. Previous to these pioneer installations it was already established that electricity was the best source of power for lighting and auxiliary drives.

So, fifty years ago the industry had practically all of the basic elements of an electrical system for operating a steel plant. A brief review of the progress made in the last fifty years will give a hint of what lies ahead. While metallurgists have been developing many completely new products and mill designers have been developing new processes for producing every type of steel goods, electrical engineers have learned how to apply electrical equipment to any process; they have learned how to build reliable electrical equipment, and they have developed power systems for supplying all of the electrical energy which is required.

Improvements in processes have been startling. Many old processes have been abandoned quite recently in terms of the complete history of the industry. Also, they have been abandoned so suddenly and so completely that most of the younger engineers have never seen them in operation. For example, for many years hand mills similar to the one shown in Figure 1 were the only source of sheet and tinplate. By man-killing exertions, two men in one hour could roll in one stand of a hand mill about one ton of sheets from reheated sheet bar less than ¾-in. thick. Input to the mill drive was about 100 kwhr per ton of hot rolled sheet. By extensive mechanization with sheet catcher tables as illustrated in Figure 2, the output could be increased materially with considerable reduction in manual efforts. A few mills of this vintage even had automatic screwdown control. However, the quality

Figure 1—Hand mills such as these were the only source of sheet and tin plate until the development of the tandem mill.

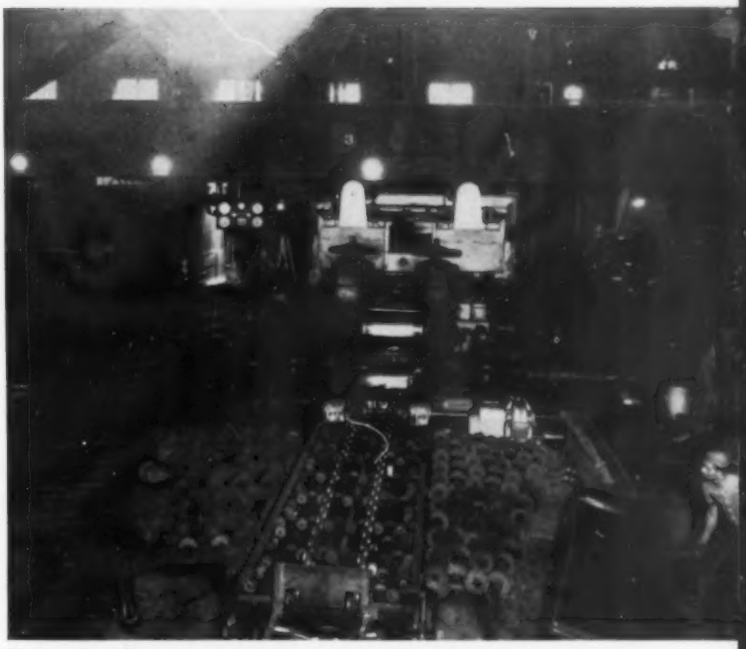


Figure 2—Some hand mills had mechanized features such as sheet catcher tables.

of the product was not particularly improved by mechanization. Most of the main drive motors were open and self-ventilated and the sulphur, carbon and iron dust in the air limited the life of the insulation.

In a relatively short period, hand mills were completely replaced by tandem hot and cold mills. Using the same 100 kwhr required to make a ton of hand rolled sheets, a tandem hot strip mill similar to the one shown in Figure 3 will roll, from a 6-in. slab, one ton of light gage strip suitable for further reduction by cold rolling. Electrical equipment as seen in Figure 4 is installed in a large, clean and well ventilated room and is seldom seen by the mill operators.

In the days of hand sheet mills, cold rolling was done only to polish the surface and to flatten the sheet. One of the more elaborate installations for this purpose is shown in Figure 5. This mill had two roll trains arranged so that each sheet of tinplate stock could be given two passes. Roll trains of this type were driven by open wound-rotor induction motors. The only electrical problem was that of starting the mill in cold weather when the roll neck friction was high. Motor operated drum controllers were used to give forced acceleration. Once the mill was up to speed and roll necks were warmed up, the load was about the same whether the mill was idling or working. Energy consumption was about 10 kwhr per ton for each pass.

Nine men, including the sledge hammer mechanic on top of the mill, are visible in this picture. It is reasonable to assume that there are at least seven men on the other side of the mill—all busy at hard manual labor, but actually accomplishing very little. These days this would be considered as one of the finest illustrations of how not to do a job.

Modern cold mills which reduce hot rolled strip to sheet and tinplate gages, polish the surface and temper the steel, may use ten times as much electrical energy per ton as the old single-pass cold mills which did practically nothing to the steel. A modern tandem

Figure 3—Continuous tandem mills have been the most important factor in keeping down the cost of sheet and tin plate. This in turn has resulted in expanded usages for the material.

Figure 4—Electric equipment for mills is normally located in relatively clean, well-ventilated motor rooms.

Figure 5—Cold rolling in the hand sheet mill was done only to polish the surface and flatten the sheet.

cold mill, similar to the one shown in Figure 6, may roll as much tonnage in one month as a complete plant for hand rolling could produce in one year. So even without taking into account the very great reduction in labor required, the additional energy is well utilized. The now familiar electric drives with all twin-motor construction and magnetic amplifier regulating system is shown in Figure 7.

Such drastic changes in processes affect not only the main electrical equipment but also the auxiliaries. For example, the steam pickler, as seen in Figure 8, required no electrical equipment. It did a fine job on batches of individual sheets and is still used for special work. However, to handle large tonnages of coiled strip it was necessary to go to a complex continuous pickling process. Four present-day pickling lines are shown in Figure 9. As steel mill engineers well know, these lines have a large amount of complex electrical equipment. A typical installation may have a total connected motor capacity of 3000 to 4000 hp.

Figure 6—A modern tandem mill can roll more tonnage in one month than a complete hand mill plant could in one year.

Many other familiar examples of equally important advances can be cited. The electrolytic processes for tinplating and galvanizing, reflowing by the high frequency induction process, electric furnaces for melting, refining and heat treating of high grade steels are typical. All of these advances depend entirely on the lavish but carefully controlled use of electricity. It is impossible to conceive how the demands of our present-day economy could be met with the methods in use a few years ago. For example, last year electric arc furnaces and high frequency induction furnaces produced 57 times as much high grade steel as was made by the crucible process in its peak year.

So, the advances in the design of electrical equipment have been as pronounced as the changes in processes. In the field of main drives, the most marked advance has been in the design and application of d-c motors and control. From the beginning there was a need for speed adjustment for most types of mills. A number of a-c adjustable speed sets were built. These drives were used chiefly for simple merchant mills and group drives. Most of them were built before 1925. The inherent advantages of the d-c motor are such that in recent years, the use of a-c drives has been confined to single-speed applications. Now we know that all of the money and effort which was spent on developing and selling a-c adjustable speed equipment should have been spent on d-c equipment.

The first d-c installation, still in operation, has two 1500-hp, 100/125-rpm motors which operate on the 250-volt system of the plant in which they are installed. One of these motors is shown in Figure 10. The field frame is made of cast iron with a box-type section. No interpoles or compensating windings are provided. Insulation is Class A. An 18-ft flywheel takes the sharp edge off the peaks, and compensates for the lack of interpoles and pole-face windings. Using the same armature core dimensions, present-day designers could

Figure 7—Many present electric drives are of twin motor construction with double armature to reduce acceleration and deceleration loads.

Figure 8—No electric equipment was required on the steam pickler.

Figure 9—Modern pickling lines have, however, elaborate electric drives and controls.

obtain a continuous rating of 3500 hp with 7000-hp momentary peak capacity. The original control for each motor consisted of a starting resistor made from 105, 25-lb and 195, 40-lb, 30-ft T rails, ten hand operated switches and two 12,000-amp, single-pole circuit breakers.

The first American reversing motor, in operation since 1907, is rated at 4000 hp, 0/150 rpm, 575 volts. This double-armature unit is shown in Figure 11. The fields are made of laminations, held in cast iron box-type frames and they have both interpole and pole-face windings. Insulation is Class A. A modern machine with the same armature dimensions would have a rating of 6750 hp. Both the motors and the generator are excited from the 250-volt plant system. Speed and direction of rotation are regulated by voltage control of the generator by means of a lever operated potentiometer rheostat. None of the regulating equipment now used for regulating voltage, current and rate of reversal was provided. Adjustable voltage power is supplied to this motor by a single generator having two armature windings and two commutators, each connected to one armature of the motor.

Modern d-c mill motors for main roll drive have wide speed range by field control. They can commutate heavy overloads and sudden changes in load without injurious sparking. And they can readily be provided with the special characteristics required for operation with quick-response control such as is used for tandem hot mills and cold mills. Likewise, by constant improvement in design and by constant extension of the use of adjustable voltage control, auxiliary motors have been made to perform complex functions which were considered impossible a few years ago.

Demands of the industry have made it necessary to provide more powerful drives as well as improved drives. For example, a large universal slabbing mill as shown in Figure 12 may require a 16,000-hp main drive as shown in Figure 13 as well as a set of powerful auxiliaries.

Not so long ago, the resistor, the rheostat, the contactor or relay, the vibrating regulator or carbon pile regulator and the limit switch were the only control devices available. When only these devices were available, the performance of automatic control was decidedly limited. Development of rotating regulators

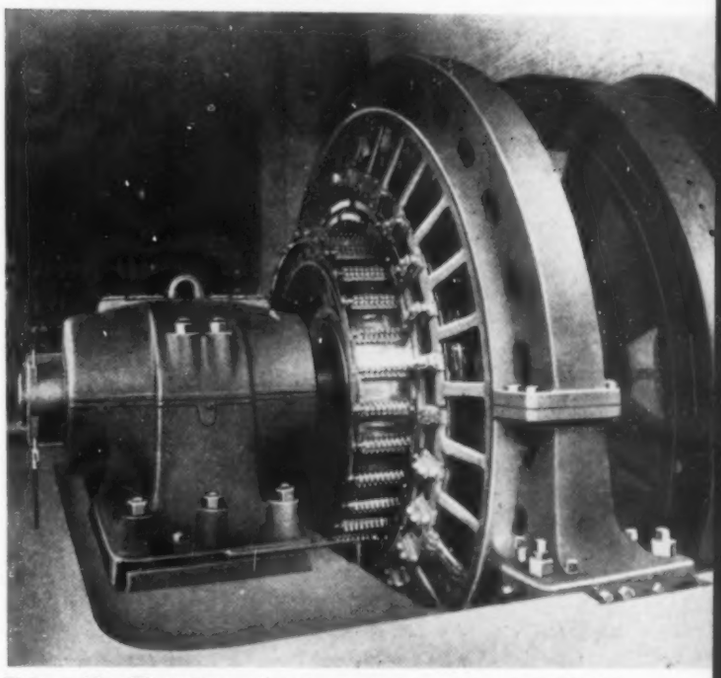
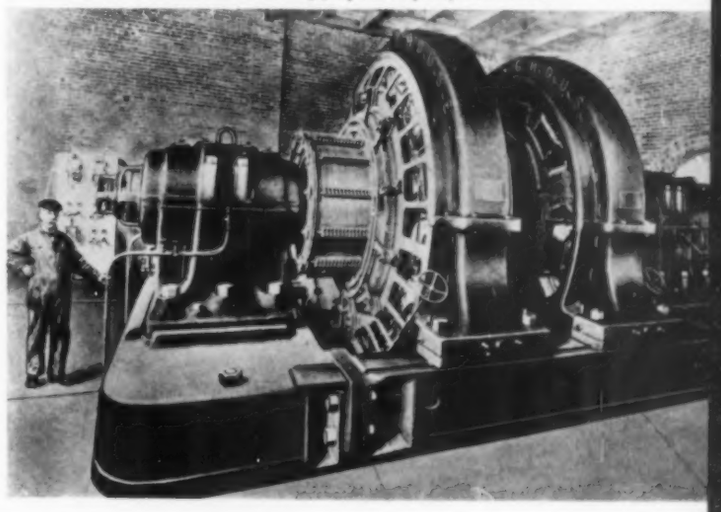


Figure 10—The first direct-current motor installation still in operation has two 1500-hp, 100/125-rpm, 220-volt motors, and drives a rail mill.

Figure 11—The first American reversing motor has been in operation since 1907. It drives a 36-in. universal plate mill and is rated 4000-hp, 0/150-rpm, 575-volt.



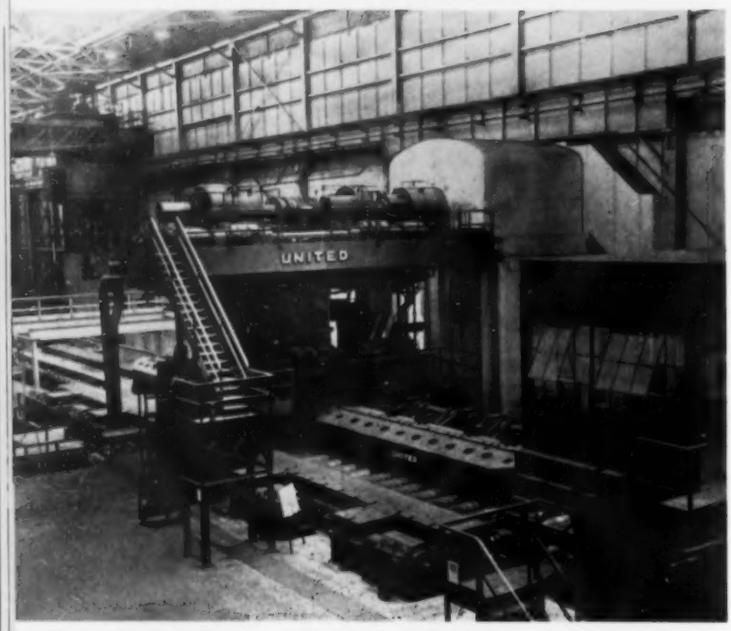
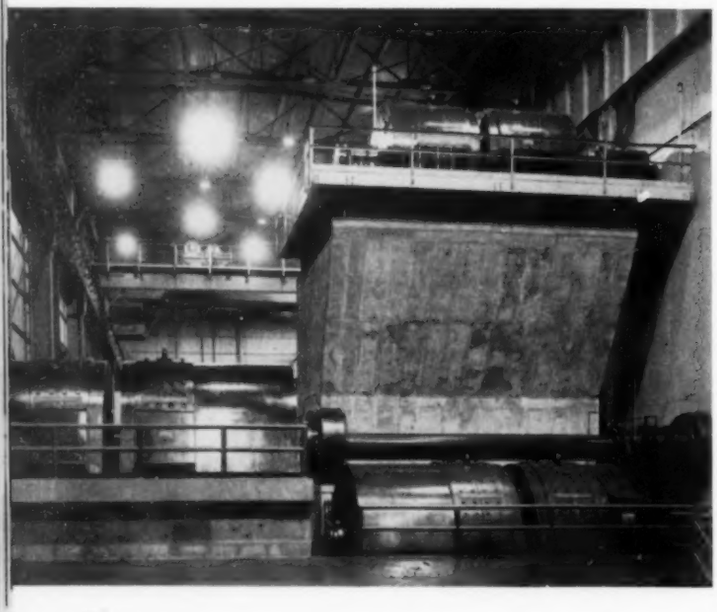


Figure 12—Present-day slab mills may use as much as a 16,000-hp on the main drive.

and more recently, of static regulators of the magnetic amplifier type, and of card programming systems has removed many of the early limitations. Most of these new devices have been described in many technical publications, including the *Iron and Steel Engineer*, so there is no need to give a detailed discussion of them here. However, it should be pointed out that these devices are not just something new, but that their use involves an entirely new line of thinking. A single example will serve to illustrate.

When the first major installation of automatic screwdown control was made in 1926, some form of limit switch was considered as an essential part of the control. To obtain the desired accuracy, it was necessary to magnify the movement of the screws by more than 100 to 1. No traveling nut limit switch of such proportions was available nor was space available

Figure 13—Slabbing mill of Figure 12 also requires a set of powerful auxiliaries.



to mount and adjust such a device. So spiral limit switches and plug boards as shown in Figure 14 were developed. In the first installation of this type, the limit switches were connected mechanically to the screwdown mechanism. In a second and duplicate installation, synchro-tie drives were used. These installations are still in service but are entirely out-of-date by present ways of thinking.

In a present-day installation for the same purpose, any desired schedule of roll settings would be punched on a coded card similar to those used for accounting. When this card is passed through a slightly modified business machine, the information on the card is stored on transistor panels for use as long as is required. When it is desired to change schedules, the original setup can be erased instantly and a new schedule can be set up by passing a new card through the business machine, which we now call a card reader.

In such a system, the limit switch has been replaced by an electrical device which does not measure distance directly, but which sends out impulses according to a coded system of numbers. This is called a digital system. In making a given movement of the screws, the motors run as long as there is a difference between the number corresponding to the screw position and the number corresponding to the final desired position. The device which is connected to the screwdown can easily be hidden under a ten-gallon hat. Signals for movement of the screws are passed through transistors to standard adjustable voltage control for the screwdown motors. Transistors and other devices of the same nature are in effect contactless relays or valves which operate with the speed of a vacuum tube, but which have none of the disadvantages of vacuum tubes.

The ultimate possibilities of this type of control are not known at present. Automatic screwdown control has been mentioned merely as an example of one use. Combinations of these new ideas and devices are also being used in blast furnace skip hoist control, material handling equipment and similar applications.

Equipment for supplying direct-current power probably has gone through more phases than any other type of electrical apparatus used by the steel industry. At first the slow speed engine driven generator was the only source of d-c power. Next came the rotary converter and the synchronous motor generator. Now the mercury-arc rectifier is being used almost exclusively for additions to 250-volt constant voltage auxiliary systems and for many main drive applications. Eventually the dry type rectifier probably will be the principal device for converting alternating current to direct current.

Progress which has been made in the last fifty years has been achieved under great difficulties. Wars, threats of war, strikes and depressions have all interfered with the orderly development of processes and equipment. When the operating rate was low, there was no money for improvements. When normal business was good or when the industry was under military pressure, the demand for more steel made it necessary to install new capacity in the shortest possible time. Under these conditions there is a tendency to duplicate some previous installation, even though certain obvious improvements should be made. Also, at such times it is often necessary to keep obso-

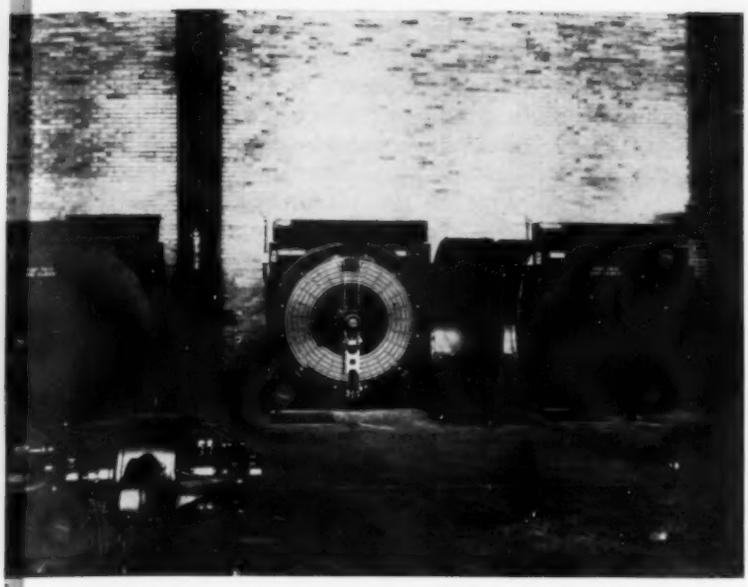


Figure 14—Spiral limit switches and plug boards were used on the first installation for automatic screwdown control in 1926.

lete and inefficient equipment in operation to meet the demand for steel.

Progress at best is relatively slow because the industry uses ponderous and expensive equipment. Under present conditions, two years or more may be required to build and install new equipment for a major plant addition. After the usual shake-down period of several months, it may be several years before the full potentialities of the installation are discovered and incorporated into the overall plant operations. Service conditions are severe so the equipment must be sturdy and it must be installed with care. This results in a long life and involves the risk that the installation may be out-of-date before it wears out. So each new installation requires careful planning.

As our economy progresses, the cycles of obsolescence of equipment grow shorter. Due to the very nature of the business, these cycles may never be as short in the steel industry as in many other industries. However, new processes will be developed and, if past experience is a good criterion, these changes in processes will be chiefly responsible for changes in electrical equipment. The present tendency to establish research departments and to set up long range plans should provide a healthier climate for future development. The steel industry will continue to require new and better equipment, and the electrical industry will certainly make every effort to meet and even anticipate these demands.

What has been accomplished so far may be summarized as follows:

1. Electricity has been applied to every operation for which it can be used to advantage.
2. Rolling speeds have been increased with very great reduction in manual effort.
3. Precision of rolling has been increased greatly.
4. A good start has been made in the development of equipment for continuous heat treatment, continuous pickling, plating and galvanizing.

If higher rolling speeds are found to be economical, ways will be found to increase mill speeds. Just now the most economical speed of many mills is well below the maximum design speed.

Greater precision in rolling, particularly for flat rolled products can be expected in the future. The possibilities of new electrical control devices which can be used for this purpose have not yet been realized completely.

And, no doubt, continuous finishing processes such as heat treating and coating will be improved.

Until quite recently, the motors used by the steel industry have been made of practically the same copper, steel and insulating materials that were available forty years ago. All that has been accomplished to date has been achieved with motors made from these materials. Recently these basic materials, particularly insulating material, have received a great deal of attention. New insulating materials which have resulted from this work promise to have longer life and can withstand higher temperatures than are now in general use. Where it is advantageous, future use may be made of this property. However, the steel industry has always, and quite properly, been conservative in the selection of ratings and temperatures. So any changes in temperature ratings will be made with the full cooperation and approval of the industry.

A discussion on this subject must be concluded long before much of the available material has even been mentioned. However, it will be evident even from so brief a review that the past years have been interesting, exciting and fruitful. It is certain that the coming years will be equally interesting and fruitful.

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

THE PREVENTION OF GAS

By
THOMAS A. WATSON,
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Power Production
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. . . . some of the basic things to remember in preventing gas incidents are that under no circumstances should anyone attempt a rescue without first putting on proper breathing equipment; men must be organized to first prevent accidents and second to minimize their effects . . . . men must be trained, and equipment must be kept available in the right locations, in good repair . . . .

▲ A GAS incident may result in destruction of equipment and loss of life through an explosion or in loss of life through the breathing of gas. Since every gas incident is potentially this serious, every effort should be made to prevent them or minimize the severity should they occur. There are degrees of severity in all gas incidents, but it must be remembered that these are the possibilities and that the severity in each case will depend on the prompt and efficient action of the operating personnel and the gas rescue squad. Minutes of time are the difference between a minor gas incident and a fatality. The efficiency of the operating personnel and rescue squads will depend on procedures developed and equipment provided and how well they have been trained in their use. The first concern, of course, is to prevent the incident from happening at all, but recognizing the possibility of human errors and acts of God, effective rescue procedures must also be developed.

This paper will be divided into three sections: (1) a brief description of the more common gases made and used in steelmaking; (2) organization, equipment and procedures for the prevention of gas incidents; and (3) organization, training and equipment of gas rescue squads to minimize the effects should a gas incident occur.

CHARACTERISTICS AND EFFECTS OF GASES MOST COMMONLY FOUND IN STEEL PLANTS

Oxygen—Oxygen is necessary for the support of life and combustion. Air normally contains about 21 per cent oxygen. Men can work in air atmospheres below this oxygen content down to about 16 per cent below which life is greatly endangered. A deficiency of oxygen in the air will cause suffocation, while a complete lack of oxygen may produce permanent injury or loss of life in a matter of minutes. Mechanical suffocation will result when sufficient carbon dioxide or other inert gases are released to dilute the normal oxygen content of air. Subjection to oxygen concentrations higher than normal, such as pure oxygen in some types of breathing apparatus, have no apparent injurious effect.

Oxygen's ability to support combustion constitutes a serious fire hazard, particularly around oil and grease, and since considerable quantities of pure oxygen are used in steelmaking, it is necessary that suitable procedures be developed for its safe handling.

Carbon monoxide—Carbon monoxide, probably the most common gas hazard in steel plants, is an explosive and toxic gas which cannot be detected by any obvious characteristics, such as smell or irritation to the eyes or nose. It is a product of incomplete combustion found in exhaust gases of internal combustion engines, coke oven gas, blast furnace gas and producer gas. Air that contains 12.5 per cent to 74.0 per cent of carbon monoxide will explode if ignited. Wherever carbon monoxide is present in concentrations of 0.01 per cent there exists the danger of toxic poisoning. Although occasionally symptoms of carbon monoxide poisoning, such as sleepiness, headache or mild nausea, are evidenced by the victim, most often he is overcome before he is aware of its presence.

The poisonous effects of carbon monoxide increases with the length of the exposure and/or the concentration of the gas. Concentrations of 0.02 per cent will

produce slight symptoms within several hours; 0.04 per cent severe effects within three hours; 0.1 per cent, death within an hour. Physical exertion will greatly reduce the time required to produce the above results.

Natural and coke oven gases—Natural gas and coke oven gas are other gases used in considerable quantities in steel plants. Natural gas will replace the oxygen in the air and cause suffocation. Coke oven gas, made up of carbon monoxide among other gases, is toxic. Both gases produce carbon monoxide when burned with insufficient air to insure complete combustion. Each will explode violently upon ignition when mixed with air within their explosive ranges.

Others—Other gases, such as hydrogen sulphide, hydrogen cyanide, benzene, chlorine and ammonia, are commonly produced or used in steelmaking and present serious gas incident potential. They should be carefully studied and procedures developed for their safe handling.

INCIDENTS

Carbon tetrachloride, commonly used in fire extinguishers for electrical fires, should always be carefully considered. Vapors of carbon tetrachloride are toxic, and toxic gases, such as phosgene and chlorine, are liberated when it is brought in contact with heat. When it is necessary to use carbon tetrachloride in a confined area, proper protective equipment must be used.

ORGANIZATION, EQUIPMENT AND PROCEDURES FOR THE PREVENTION OF GAS INCIDENTS

Organization—The success of any program for the prevention of gas incidents hinges directly on the organization which administers it. The final responsibility for the administration of the program must rest with the operating superintendent. He must clearly define responsibility and authority within his organization and insist that all rules be obeyed and procedures followed. Most of all there must be strict discipline at all levels within the organization. The operating foreman must not tolerate any compromising of the rules or lackadaisicalness in the execution of the safety procedures. He must no more think of turning a blast furnace gas goggle valve, light off a gas-fired boiler, start an acetylene station or any other operation where gas is involved, without carefully following the approved check list, than would an airline pilot take off his aircraft without checking the engines with his check list.

The operating superintendent will, of course, be assisted by his safety committee who will develop and approve the rules and procedures, the safety bureau in matters of safe procedures and suitable equipment and the training bureau in the training of his personnel.

Figure 1—A portable carbon monoxide alarm provides a means for providing a continuous check on the amount of carbon monoxide in the atmosphere.

In summary, the prevention of gas incidents is the duty and responsibility of the operating organization and must have the active interest and support of all its members.

Equipment—There is available to the industry proved and reliable equipment required for carrying out a program for the prevention of gas incidents. This includes equipment for the detection of toxic gases, oxygen deficiency and explosive mixtures. Because carbon monoxide is so deadly and so common in steel plants, most of the instruments used to detect toxic gases are designed to include carbon monoxide. They can be procured in hand-operated portable units, power-operated portable units and multiple sampling fixed units designed for specific application.

Figure 1 shows a carbon monoxide alarm which provides a means of maintaining a continuous check on the atmosphere where men must work under constant threat of exposure to carbon monoxide.

A common type of oxygen deficiency detector is a "safety lamp" in which a flame burns behind wire gauze which prevents ignition of the surrounding atmosphere. The flame will be extinguished when the oxygen in the atmosphere is below 16 per cent.

The combustible gas indicator is a portable instrument designed to detect the presence of explosive mixtures. The explosimeter is a small sized model of the combustible gas indicator.

Procedures—Procedures for the prevention of gas incidents should be carefully written and reviewed by appropriate committees, then disseminated to all concerned. Procedures, however carefully prepared, are of little value if the operating personnel are not clearly familiar with them. Time being limited, the following procedures are presented as examples of some being used by a utility division of a steel plant. They are cited as examples of procedures which should be developed for operations peculiar to each works.

GENERAL PROCEDURES AND PRECAUTIONS TO BE OBSERVED IN AND AROUND BOILER HOUSES TO PREVENT GAS INCIDENTS

1. Permanent type carbon monoxide detectors with alarms should be installed in critical areas of the boiler house to detect leakage.

2. Whenever it is necessary for cleaning or repairs

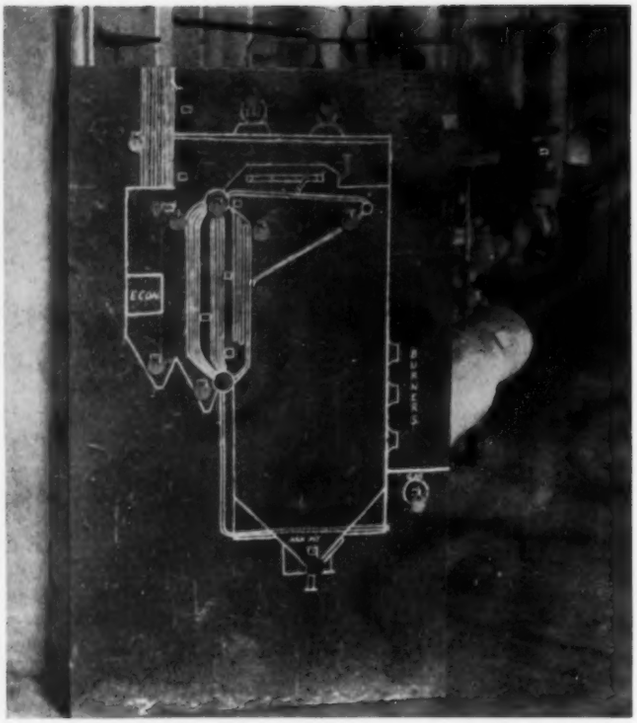


Figure 2—A portable sketch board helps account for all the men working in the boiler and shows their location.

to be performed inside of the boiler proper, economizer, ash pit, boiler breaching, induced draft fan housings, or stack, all gas mains leading to the boiler must be blanked off with solid plates or goggle valves. Before anyone enters the boiler, the section of the gas mains from the blank to the boiler will be purged and tested. Whenever workmen or inspectors are in the boiler, provisions to circulate air by the induced draft fan or air movers must be made.

3. Permanent provisions must be installed on all gas mains for purging with steam or other approved purging medium.

4. Extremely close supervision must be maintained over personnel working in and around a boiler, including some definite system of accounting for all personnel at the start and end of the turn.

Figure 2 shows a portable sketch of the boiler with hooks on which each man places his tag before he enters that particular section of the boiler. Only the man who placed the tag may remove it. All men must be accounted for before the boiler gas main may be sealed.

Before admitting blast furnace gas into the manifold of a boiler a systematic check, using check lists, must be made of all openings. The person in charge of starting the boiler must personally make these checks. Figure 3 shows the boiler house foreman making such checks.

PROCEDURE FOR LIGHTING A GAS-FIRED WATER WALLED BOILER

It is not the purpose of this procedure to cover the complete detail of preparing and lighting the boiler, but rather to deal only with the portion which might involve a gas incident.

Assuming that the boiler is otherwise ready to

Figure 3—Boiler house foreman is using a check list in inspection of boiler prior to admitting gas into the burner.

light off, the following steps will be taken under the direct supervision of the foreman in charge of the station.

1. Start the induced draft fan controlling the motor speed or fan dampers to produce a slightly negative fire box pressure.

2. Close the gas burner valves.

3. Fill gas seals on burner manifold drains. Check overflow indicators to be sure they are full.

4. Purge the section between the goggle valve and the boiler with approved purging medium.

5. Open the blast furnace gas goggle valve in accordance with established procedure.

6. Check the fire box to see that none of the gas burner gas valves are leaking.

7. If natural gas or coke oven gas is used for pilots or secondary fuel, purge these lines in the same manner.

8. With all burner gas valves shut off, allow adequate time to clear the boiler and stack of all gas.

9. Light the torch and place it as near as possible to the pilot burner in the fire box. The man handling the torch must wear a face shield.

10. Open valve controlling gas to pilot and observe the burner to be sure it stays lit.

11. Remove the torch and place it in the snuffer.

12. At the proper time, start the forced draft fan and bring on the main burners. Observe to make sure that the burner stays lit. If necessary, make required adjustments to the combustion air. While observing any burners, a face shield must be worn.

PROCEDURE FOR OPENING BLAST FURNACE GAS GOGGLE VALVES AT POWER STATION BOILERS

1. Provide sufficient self-contained breathing apparatus for each member of the crew with some extras as spares.

2. Close all windows, doors and louvres on buildings in the area.

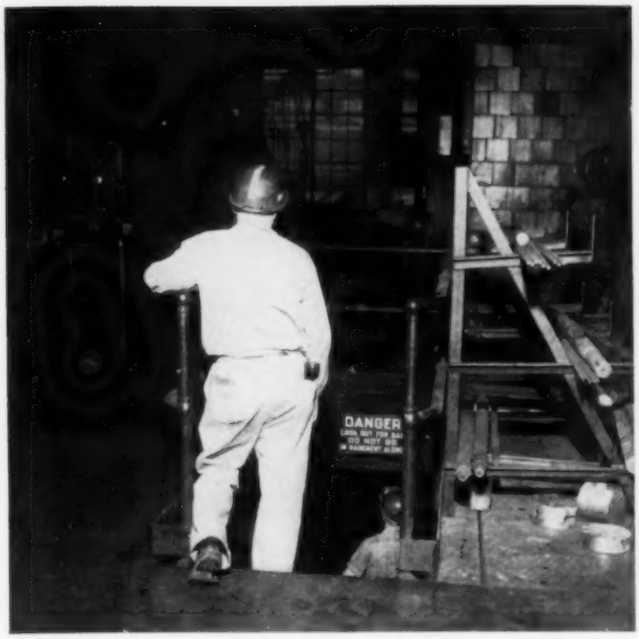


Figure 4—Sign warns men not to go alone into the basement.

3. Notify all interested personnel in the area that the goggle valve is to be turned.

4. Make a check of the area to see that no one is working in the area who might be affected by the gas.

5. Place signs on the roadways and flags on the railroad tracks to warn drivers or engine crews to stay out of the area.

6. Close and lock out burner valves.

7. If the boiler is in operation using other fuels, open the steam purging valves, or admit other purging medium, such as carbon dioxide, to the section between the goggle valve and the boiler burners.

8. Crew to turn the valve will put on the breathing apparatus and proceed to the valve controls.

9. Turn the goggle plate either manually or by power, whichever is provided.

10. Purge the purging medium out of the section between the goggle valve and the boiler burners. The progress of this purging should be checked with appropriate instruments. If the boiler is out of service, and cold, the section can be purged through the boiler with the induced draft fan by opening one burner valve at a time.

GENERAL PREVENTIVE MEASURES FOR PREVENTION OF GAS INCIDENTS AROUND GAS ENGINES

1. Water seals are filled when engine is shut down. This can be checked by observing the overflow at the seal.

2. Engine is purged of gas by turning the engine over with compressed air while the drains or vents on the gas main are open.

3. When working on inlet valves, throttle valves, exhaust valves or inside the cylinders, the goggle valve or plate after the water seal must be closed. If a goggle valve is used it must be locked.

4. A compressed air-powered air mover or evacuator is used to clear the engine cylinder or crank case housing before work is started. Air mover is kept in operation while work is being performed.

Figure 5—A suction type ventilating system is used to remove the gas which might be leaking around the piston rods in the engine room.

5. When working on throttle valves or cleaning gas mains, an analysis with a carbon monoxide detector is made before work is started. Air mover is used throughout the job.

6. Men working in the gas seal pit must wear self-contained breathing apparatus unless the goggle plate leading to the gas seal is closed. Before working in a gas seal pit, an analysis is taken with a carbon monoxide detector. An air mover is used and a carbon monoxide detector with alarm is used continuously while men are working in the pit.

7. The atmosphere surrounding the engines is checked for concentration of carbon monoxide whenever it is deemed necessary.

8. No one should enter gas engine basement alone; they should be accompanied by another person. Signs, similar to the one shown in Figure 4, should be posted at each stairway stating this rule. When it is necessary for men to work in the basement, a responsible person on the operating floor shall be notified. It will be the responsibility of this man to check on the welfare of these men.

9. Suction type ventilating systems, similar to the one shown in Figure 5, should be used whenever the engine is in operation.

10. The packing cases at engine cylinder heads should be checked with carbon monoxide detectors periodically and when there is suspected gas leakage.

11. The water seal overflow is checked visually at frequent intervals when engines are down.

12. Provision should be made to fill seals with a hose attached to a separate supply source should water supplying seal fail.

13. Carbon monoxide detectors and alarms should be in service continuously in gas engine stations to detect any excess concentration.

14. Forced air ventilating systems should be installed to heat and ventilate the entire station.

Suitable signs should be posted at all entrances and other places around the engine warning all personnel of the possible presence of gas.

PROCEDURE FOR SHUTTING DOWN A GAS POWER ENGINE FOR MAINTENANCE

This procedure is intended to describe the laying up of a gas engine generator after it has been taken off the line. The steps outlined below are considered necessary to safeguard the life and limb of the men who are to perform the work on the engine in positions where any movement of the engine might cause injury.

1. Check to make certain the disconnect switches are open and necessary tags placed on switches. This is done with the assistance of the electrical operator in the station.

2. Close the throttle valve on each side of the engine and allow the engine to come to rest.

3. Turn off the ignition.

4. *Fill the water seals.*

5. Open drains on gas mains; open throttle valve three or four turns.

6. Open the quick opening air starting valve located adjacent to the throttle valves, and allow the engine to rotate eight to ten revolutions to purge the gas from the throttle valves and gas mains, through the engine.

7. When work is planned on inlet valves, throttle valves, or inside of the cylinders, the goggle valve or plate on the engine side of the water seal must be closed. If a goggle valve is used it must be locked.

8. Open the indicator cocks on all cylinders.

9. Close the air starting header valve located in the basement. Tag out valve.

10. Open the 1½-in. relief line valve, located in the basement between the air starting header valve and the quick opening valve to dissipate any air which might be trapped in this section of the pipe.

11. Again open the quick opening valve. Close the valve and place chain and lock on the operating lever for this valve. A lock must be placed on this lever by the man in charge of each crew working on the engine.

12. When repairs are being made on the engine which require that men are so positioned that movement of the engine would endanger their safety, the flywheel should be blocked. Place blocking on each side of the flywheel to prevent any movement of the engine.

13. Close the valve in the line supplying cooling water to the engine.

14. Stop the lubricating oil pumps.

PROCEDURE FOR TURNING A BLAST FURNACE GAS MAIN GOGGLE VALVE PLATE AT ENGINE

The goggle plates considered in this procedure are those located outside the building, installed after the water seal. The water seal must be filled before goggle plate is turned. The gas engine must be taken out of service, stopped and purged and laid up according to established procedure. The crew to turn the goggle plate must consist of four men and, under normal operating conditions, these men would be members of the repair crew. The crew to turn the goggle plate must be equipped with self-contained breathing apparatus.

A carbon monoxide detector must be immediately available for use.

1. The gangleader and/or foreman will inspect the area around the goggle plate to be turned to find any obvious unsafe conditions and to make certain the area is clear of people.

2. The gangleader and/or foreman will post signs stating "Danger, Gaseous Area" around area for a distance of 15 ft.

3. The gangleader and/or foreman will inspect water seal to make certain it is filled. This can be ascertained by looking at the overflow. If water is flowing, the seal is filled.

4. The men assigned to the job will collect necessary tools, sealing cement and equipment and place them in a convenient place near the job.

5. The men assigned to the job will don the breathing apparatus, making certain they can breathe properly. They will proceed to the area, under the direction of the gangleader or foreman.

6. Under the direction of the gangleader or foreman, they will loosen all bolts around the flange and remove all the bolts except the king bolt.

7. When bolts have been removed, the flanges must be jacked apart by means of a hydraulic jack or equivalent to provide clearance for turning plate.

8. When flanges have been spread, the plate will be turned 90 degrees and the surface of the plate, which seals between the flanges, scraped clean.

9. When the plate has been cleaned, new sealing cement must be applied.

10. After sealing cement has been applied, turn the plate an additional 90 degrees and line up the bolt holes.

11. Replace bolts and remove jack. Tighten bolts, making sure all bolts have been tightened to form a tight joint.

12. The crew will then walk away from the area and remove the breathing apparatus.

13. The area around the place and the joint will be checked for leakage by means of a carbon monoxide detector.

14. If the area is found free of gas, the warning signs will be picked up and returned to the engine room.

15. The breathing apparatus used will be replaced with cleaned and reconditioned equipment by the gas rescue equipment service.

16. The gangleader or foreman will then notify the repair crew to start the work on the engine or notify the engineer to start the engine.

LIGHTING

When it is necessary to work in atmospheres which may contain any inflammable gas where artificial

Figure 6—The gas equipment service shop is essential to keep equipment in top notch condition.

light is required, only approved types of portable lights such as extension cords equipped with vapor-proof globes, permissible electric cap lamps, and flashlights should be used. No open lights should be permitted and workers should use every possible precaution to avoid causing sparks which might cause an explosion. Before going into such areas, of course, a test should be made to determine the concentration of the gases present, in order that proper ventilation may be provided or that approved breathing apparatus may be worn by the men if necessary.

ORGANIZATION, TRAINING AND EQUIPPING OF GAS RESCUE SQUADS

As mentioned previously the first objective is the prevention of gas incidents, but provision must also be made for minimizing the severity should an incident occur. As was the case in the prevention of gas incidents, the organization is also the most important aspect of the rescue program, and here again the operating department must assume the responsibility for training and equipping its personnel for effective rescue work. Plant agencies available to assist the operating department in training and rescue work must also accept their responsibilities in the program. The gas equipment service crew must effectively discharge its responsibilities in maintaining the detection and protective equipment which will include periodic inspection to insure that apparatus located in the field is continually in serviceable condition. A joint responsibility shared by the plant protection department and medical department is that of providing ambulances with suitable first aid and rescue equipment, and personnel trained to man them. Procedures must be developed for the effective handling of victims delivered to the plant dispensary. The plant safety bureau must assume its responsibility for helping to develop and approve safe procedures for working in gaseous areas and advising those concerned of the availability of improved detection and rescue equipment. The training bureau assists in the program by providing training material and instruction as required. The engineering department must discharge its responsibility to the program by reviewing all new installations and modifications to existing facilities to eliminate potential gas hazards. Figure 6 shows an equipment service shop for inspection and repair of all gas equipment.

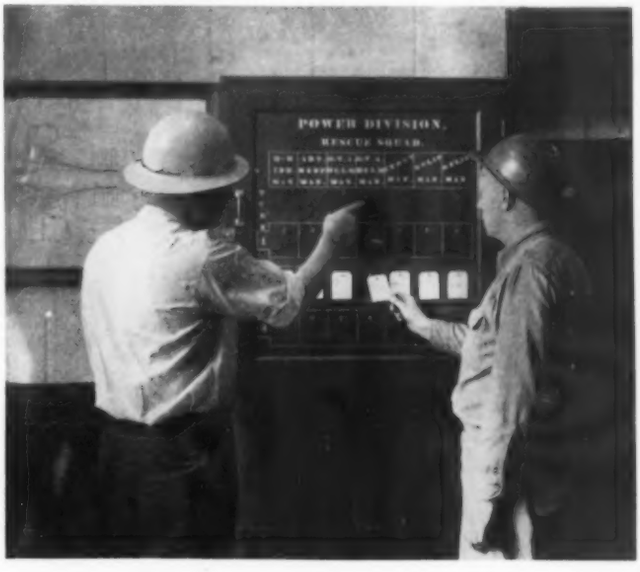
GAS RESCUE SQUADS

Organization—Each department must train a sufficient number of gas rescue workers to insure the protection of personnel within their operations. In choosing the rescue personnel, qualities such as dependability, alertness, intelligence and physical fitness should be sought. They should be emotionally stable and be able to accept discipline readily and willingly. Candidates selected must be certified as physically able to wear protective equipment required in gas rescue work.

The composition of a rescue squad may have to be modified to conform to local conditions and to the availability of personnel. An organization which has been found to perform with efficiency under most conditions consists of seven men, as follows: a squad captain to size up the situation and direct the activity of the squad; two stretcher men to deliver stretcher and blankets to the assembly point and assist in artificial respiration; two rescue men who will report to the assembly area with breathing apparatus prepared to remove the victim from the gaseous area; and two resuscitator men who deliver the resuscitator or inhalator to the assembly area and place it into service.

Training—The training of the rescue squad must, of course, start with the training of the individuals. His training must be thorough and complete and include the following: operation and limitations of the rescue equipment, including the breathing equipment, inhalator and resuscitator; transportation of the victim to safety using the various carrying and lowering equipment; instruction and practice in artificial respiration and first aid. The back-pressure arm-lift method of artificial respiration is generally preferred, but another method should also be taught in case the victim has also been injured around the chest

Figure 7—A badge board indicates the availability of the gas rescue squad.



or shoulders. First aid is a very important part of the training of the rescue squad as very often the victim, in addition to being gassed, has also been injured. They must be taught to handle victims with broken bones, open wounds and serious cuts without inflicting further injury. In addition to the control of profuse bleeding, they must know how properly to treat persons in shock.

The rescue squad can function as soon as each man is competent in his specialty, but training should be continued until each is an expert in his specialty and competent in the others' duties.

Equipment—Many excellent types of instruments are available to the industry for gas rescue work from which selection can be made to meet local conditions. Training drills with simulated victims are an excellent test of the adequacy of equipment, particularly that required for removal of unconscious victims from potential gaseous areas.

PROCEDURES AND FACILITIES FOR EMPLOYMENT OF THE GAS RESCUE SQUADS

Procedures must be developed and facilities provided to make every second count in employing the rescue squad quickly and efficiently. The details can be handled in several ways but all should include the following considerations.

Determination of gas rescue squad availability—Some systems should be devised to permit the person responsible for the activities of the squad to determine their availability. One suggested method is the badge board shown in Figure 7.

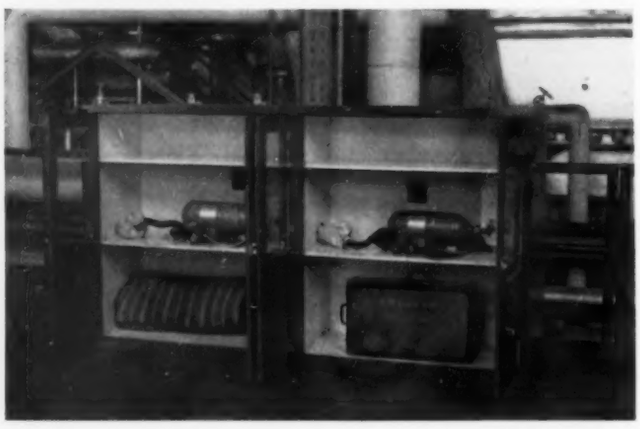
After a man has received training and qualified as a member of the rescue squad, a badge with his name and qualifications is hung on the inside of the badge board cabinet. When the man becomes proficient in other squad duties, these skills are added on his badge. As each man reports for work in the area, he hangs his badge on the board under a vacant crew position he is qualified to fill. When he leaves the area, he removes his badge and returns it to its place inside the cabinet.

By consulting the badge board at the start of each turn, supervisors in the area can readily determine which members of the rescue squad are available and take action to fill any vacancies.

Care and storage of gas rescue equipment—Proper maintenance and regular inspection of gas safety equipment is fundamental to the success of a gas safety program. In an emergency, equipment that is not in good working order is useless.

Suitable equipment storage cabinets, as shown in Figure 8, should be installed throughout areas where there are potential gas incidents. These cabinets should be sealed to permit a quick check on the use of equipment in the cabinet. If the seal is not broken, the inspector will know the equipment has been unused since it was last inspected. Once each month the seal should be broken by an inspector from the gas rescue equipment service, and the equipment checked for serviceability. Immediately after use, the gas rescue equipment service should be notified to recondition the equipment used and reseal the cabinet.

Figure 8—Suitable equipment storage cabinets should be installed through the area where there may be potential gas incidents.



Alarm stations—Alarm stations where individuals may manually signal the need for a gas rescue squad should be strategically located throughout areas of potential gas incidents. An excellent system is one which employs both sound and visual signals. The signal station should consist of a switch which will sound the alarm and light a light indicating that the alarm was turned in from that station. A master station centrally located should have signal lights indicating which station turned in the alarm. The alarm should be a signal which will be readily recognizable for what it is. It may be a siren, or in some particularly noisy area, a flashing light might be used in addition to the siren.

Gas rescue drills—To reach and maintain a high state of efficiency, the training of the gas rescue squad must be continuous and include frequent drills. The drills should be as realistic as possible, although precautions must be taken not to have the drills mistaken for emergencies. A rescue drill should be staged complete with simulated victim or victims in areas containing potential gas incidents, using the regular signal system provided. Upon hearing the alarm, the gas rescue squad will assemble complete with their various items of equipment and go into action. They will employ the normal equipment in effecting the rescue and reviving the simulated victim. During the drill, the people responsible for gas rescue training will observe the efficiency and effectiveness of the gas rescue squad and make necessary on-the-spot corrections. Upon completion of the drill, the squad should be assembled to discuss any deficiency noted during the drill. In addition to drills involving the complete squad, frequent training sessions in the use of artificial respiration and the inhalator should be conducted on an individual basis.

SUMMARY

All efforts should be directed toward the prevention of gas incidents but should one occur a few of the very basic things to remember are:

Never, under any circumstances, attempt a rescue in a gas-filled or oxygen-deficient area without first putting on the proper breathing equipment.

No man will be immune to gas in an area where another man has collapsed.

Gas is deadly. Its presence calls for more than courage; it calls for knowledge of what to do.

Train your men well—you may be the victim.

Stamping plant requirements are to wider sheets of improved drawing quality, with finer surface finishes and greater ductility . . . . stamping plants are also looking for better scheduling and packing.

Effect of Stamping Plant Requirements on Steel Industry Operations

By
A. J. HOLE,
General Manager
Metal Stamping Division
Ford Motor Co.
Dearborn, Mich.

▲ THE subject of "The Requirements of the Stamping Plants and Their Effect on the Steel Industry" is one with many facets.

Steel is basic to our national economy and development. The auto industry uses approximately 20 per cent of the nation's steel—alternating over the years with the construction and maintenance industry as the top steel user. Since 1947, autos have been the top industry in the use of steel and have helped force increased steel production.

The steel industry has understood its place in the economy. There are 430 plants making or finishing steel in 270 communities in 31 states. Its postwar expansion and modernization program costing $7,000,000,000 raised its annual steel making capacity to 125,828,310 net tons as of January 1, 1955, for an increase of about 34 per cent since January 1, 1946, including some 15 to 20 per cent of capacity as standby reserve for emergency. Recent expansion programs announced by steel companies for the next few years reflect increased capacities of close to 10,000,000 tons of ingots according to Ernest T. Weir, Chairman of the National Steel Corporation. To meet American requirements, he estimates that at least 12,000,000 tons must be added to present annual steelmaking capacity by 1960. Population increase, increased per capita consumption of steel, and a world movement towards higher standards of living, which in turn is hinged on steel, is the basis for another estimate that some 75,000,000 tons of capacity annually may be installed during the next 25 years.

Looking to the requirements of a stamping plant—from the manager's point of view—we must consider present operations and probable future developments.

Today's pressroom foreman still is looking for more "rubber" in his steel. He also seeks a better surface finish and is hopeful that general performance and formability can be improved so that he can meet present day schedules and quality standards.

The requirements of this extremely competitive industry for high quality, places even more stress on the foreman to take an increasingly critical look at the steel he receives with which to make body parts. Likewise he is still just as anxious as ever that his concern about quality rub off on his press operators while they work to meet production schedules.

Stamping plants also are concerned with more efficient press operations, availability of storage area, ease of handling large coils, and elimination of downtime resulting from unsuitable sizes of steel coils. The increasing problem of stamping plants is to obtain the kind of steel required in the quantities and manner desired to meet their production schedules.

The trend in the stamping plants in the metal stamping division of Ford Motor Co. is to handle larger coils—both in width of sheet and outside coil diameter. The larger the coil, the better chance we have of reducing handling costs (a saving also available to the steelmakers), reducing downtime on blankers, and the reduction of scrap, provided the coils contain quality steel throughout.

These factors are important to us. We handle about 6800 tons of steel daily with about 77 per cent of our requirements furnished in coils. In one instance on a fender job, we established a requirement of a 0.036 x 47½-in. coil with a 24-in. inside diam and a 66-in. outside diam weighing 38,800 lb. Had the supplier furnished us coils of this weight we would have received 222 coils in December. Instead, he shipped 311 coils of varying weights—or an excess of 89 coils. Some coils weighed as little as 2000 and 4000 pounds.

The following inefficiencies resulted. First, there was 10½ hr lost in downtime at the blankers. Second, the 1 and 2-ton coils created potentially hazardous storage conditions. Third, these small coils were eventually sent into the plant to be cut up for small parts for which we previously had ordered other steel.

In another case requiring coils weighing 55,600 lb each, 145 coils of varying sizes were delivered rather than the 104 specified. Resulting downtime at blankers amounted to 5 hr. This problem we are solving.

Styling requirements of today's automobile tend toward much wider sheets of steel of more uniform grade, with high mill surface quality and uniform ductility throughout the coil. The steel must be of top drawing quality if it is to be capable of the complex multi-direction deformations required in present automobile designs.

Past styling has demanded an input of steel per car which, it has been estimated, probably reached an all-time high last year. New styling should require no more steel per automobile on similar sized automobiles, the major changes being a trend toward a much wider sheet than previously used, with higher surface finish qualities.

Present styling trends and advanced manufacturing practices are gradually reducing the amounts of usable offal. Small parts, formerly produced from offal, may have to come from low-grade, low-cost coil steel. Offal recovery and utilization, however, still is a major factor in holding material costs down in the auto industry.

The need for top quality steel is felt, too, in the area of improved press efficiency. Only six short years ago, most large presses were quite limited in their ability to make large stampings. Today, very large presses in automobile body stamping plants, with automatic feeding and ejector equipment, operate at speeds over three times that of those presses six years ago. Line presses with shallower draws go four times higher and yet drawing speeds have been reduced by a third or more. As a result more parts of higher quality with less scrap are produced. Future press developments, of course, indicate even better performance.

With these steel requirements in mind, we are still aware of our responsibility to maintain our tools in a uniform condition to eliminate any possible fault on our part for troubles with steel. Improvements in steel, likewise, must be combined with improvements in equipment, tooling, and methods in order for the steel and auto industries to progress together.

The steel industry has increased capacities and improved methods in the past to meet stamping plant demands for quantity and quality. Continued improvements will help reduce imperfections in surfaces and roll shapes which mean flatter sheets with less tendency to buckle. Our tremendous demand for flat rolled products has developed a close integration between the steel and auto industries which must continue if we are to meet the demands of our economy to the mutual benefit of all concerned.

In the matter of scrap alone, at the rate steel is used in metal stamping plants, the savings of only 1 per cent per year would result in fantastic economies—all to the customer's advantage. Thus, the elimination of scrap, regardless of whether it originates in the steel mill or the stamping plant, is a mutual problem requiring the closest study and integration of effort.

Steel of even greater drawing quality would help solve the problem of scrap in stamping plants. When parts just cannot be made with the available steel, design changes may be the only solution to scrap problems. We then readily go to the expense of these changes in order to compete, rather than produce poor quality parts that remain unsatisfactory, often after rework.

It is quite apparent, therefore, that the effects of stamping plant requirements on the steel industry emphasizes the need for steel of improved drawing quality with finer surface finish, greater ductility, and for better scheduling and packaging. The effects will be to reduce mill and plant handling costs, to reduce mill and stamping plant scrap, and to improve our ability to more fully utilize new and more efficient pressroom equipment.

In view of the readiness of the steel industry in the past to work with the stamping plants to anticipate and meet our demands, there is a bright future of progress between us. That progress can only lead to a continuation of the greatest economy in the world.

DISCUSSION

PRESENTED BY

D. H. DELLINGER, Great Lakes Steel Corp., Ecorse, Mich.

J. E. BRENNAN, General Manager, Automotive Body Div., Chrysler Corp., Detroit, Mich.

IRA A. RICE, Assistant General Master Mechanic, Fisher Body Division, General Motors Corp., Detroit, Mich.

FRED KRAUSE, Manager, Rolling Mill, Ford Motor Co., Steel Division, Dearborn, Mich.

D. H. Dellinger: I would like to ask if there is a comparison of the amount of damage normally experienced in rail shipments versus truck shipments of similar commodities.

J. E. Brennan: It is practically non-existent with truck shipment.

D. H. Dellinger: In other words, truck shipments are virtually damage-free, and damage is essentially on rail shipments?

J. E. Brennan: Yes.

Ira A. Rice: When, if ever, will the steel industry be able to eliminate saw tooth edges on coil and sheet steel? This condition creates a major item of production downtime.

Fred Krause: This question is a slight reversal on the real theme of the meeting, but we will be glad to answer, if we can. Do you not find that more prevalent during periods of shortages of steel? It does occur in large coils, and that is one of the reasons why you get small ones. When the quality control people find it, they ask that it be removed, and there is no way now without going through expensive operations of putting the coil back together again after it is taken out.

However with only a small amount, it is sometimes felt desirable to continue on with a large coil. It occurs from quite a few sources, principally a pull in the mill at the hot strip with not enough material, or a badly cambered sheet that comes off the hot sheet mill that does not allow for sufficient treatment on one side, or will not run in the trimmers particularly.

You want steel at as low a cost as possible. We might accommodate you with double trim material, and we would bring it through wider and we would get it out twice. However, we do not get paid for that. A small amount of it stays in the coil. It does make trouble, and we admit it.

I do not think we could make every inch of a coil weighing 50,000 lb perfect. If we did, if we chose to ship that sized coil at all times and every in. of it perfect, I think you might have to pay $200 to $250 a ton for the steel. I am not trying to be facetious, but that is the way it works.

When the body panels that the stamping plant ships to the final line have something found wrong with them, it does not seem too bad to the stamping plant operators and they feel the people on the final line can do a little hand-finishing, and so forth. I have been through that often.

I am sure that we all look at automobiles today and say, "Why, we are paying three times as much as we used to." We are contributors to that high cost because some of the faults that we build into the product continues to demand labor, even hand labor, in the finishing of it.

I have been in the fortunate position of being associated with the company a long time in the processing of the steel or in the fabricating of it. I do know that there are many difficulties, and I can appreciate the criticism that has been given here. I want all of you to join me in accepting it as a challenge. I think that is the way we should go away, because when steel becomes plentiful, the stamping people are really going to get tough. I do not think we have heard the end of it yet. It is not only surface, the width, the flaking, stretchers, stringers, etc. Wait until they start making what the automobile engineers present in the next couple of years. They do not feel we are ready for it, but competition may force them into making spectacular demands on the industry.

I am sure that most of us are familiar with the sheet roll product, are aware of many of the problems that stare us in the face in future automobiles and in what the customer demands.

MINES BUREAU SPEEDS RESEARCH

Congressional appropriations for the Bureau of Mines for fiscal year 1957 will enable it to intensify nationwide research in metals and nonmetals essential to defense and industrial progress as recommended by the President's Advisory Committee on Minerals Policy.

Funds totalling slightly more than $22,000,000 were made available to the Bureau for conducting field studies and for maintaining experiment stations and laboratories in 27 States and Alaska.

As part of the stepped-up program for metals and nonmetals, mining research will be expanded and directed toward establishing and developing engineering principles that will promote safer and more efficient mining practices. This work, to be conducted in close cooperation with industry and with other research organizations, will cover every phase of mining. It will include investigations of methods and costs of both underground and surface mining of all nonfuel minerals, research on rock mechanics, drilling and blasting, studies of ore-sampling theories and practices and area studies of major mineral resources.

The minerals program will cover more than 70 items. Highlighted among projects to be accelerated or expanded are:

FERROUS METALS AND ALLOYS

In cooperation with a major steel company, the Bureau will use its experimental blast furnace at Pittsburgh, Pa., to investigate smelting characteristics of various iron ores and agglomerates of different types and sizes. In addition, the Bureau's steel program will be intensified to include basic research in high-temperature reactions and other phases of steel technology.

The Bureau will speed research on iron ore to find ways of meeting rapidly increasing demands for pig iron and steel that have depleted domestic direct-shipping ores. It will investigate iron ore deposits in the North-Central Western States and conduct laboratory studies to develop methods of beneficiating low-grade materials in Arizona, California, Colorado, Minnesota, New Mexico, Nevada, Oregon, Utah, Washington and Wyoming. Further research on beneficiating and agglomerating low-grade red ores and iron-bearing sandstones of the southeastern United States will be intensified.

Chromium will receive increased attention, with the Bureau emphasizing studies designed to permit use of off-grade materials. Other research will be aimed at developing low-cost methods for producing high-purity vanadium as a by-product of uranium milling operations.

LIGHT METALS

Through a widespread program combining field investigations and laboratory studies, the Bureau will obtain information on the quality and extent of titanium mineral reserves in the United States. Both the titanium metal and titanium pigments industries are expanding rapidly and, by providing comprehensive information on deposits of raw materials, the Bureau's work will help assure their continued growth. The Bureau will also enlarge its laboratory and pilot-plant studies to reduce costs of producing high-purity titanium metal.

Consumption of titanium, aluminum and magnesium is growing steadily both in the United States and abroad. To provide industry and Federal planning agencies with information that will assure sufficient ore supplies and production capacity for these metals in an emergency, the Bureau plans to re-evaluate supply-demand situations for them frequently during the 1957 fiscal year.

COPPER, LEAD AND ZINC

The Bureau plans expanding its research in the fields of copper, lead and zinc. Known reserves of these materials will be evaluated and the search for new ore sources speeded up. Metallurgical research on all three metals will be intensified, and studies to develop better mining techniques will be pushed to help domestic mines improve their competitive position.

By NEIL C. YOUNGS, Assistant General Sales Manager, Michigan Bell Telephone Co., Detroit, Mich.

MODERN STEEL MILL COMMUNICATION SYSTEMS—

. . . . on February 14, 1956, an unusual demonstration of industrial TV was given before the Detroit Section of AISE . . . . members of AISE in their meeting auditorium watched on live TV the operation of a hot strip mill in the Detroit area . . . . camera setup was such that the audience could jump from scene to scene or follow a particular slab through the entire operation . . . .

▲ THE Michigan Bell Telephone Co. and the Ford Motor Co. prepared a program for the Detroit Section AISE that was quite unusual in that the audience at the meeting saw the actual operation of the hot strip mill of the Ford Motor Company, Steel Division, at the Rouge Plant at Dearborn, Michigan.

A complete industrial TV network was set up consisting of four cameras at the Rouge rolling mill, microwave facilities to transmit the video to the viewers in the building where the meeting was located and a wire line circuit to transmit the audio from the mill to the auditorium.

Camera No. 1 was located on the delivery side of the slab furnace on top of the control house. This showed the hot slab coming from the slab heating furnace and entering the first roughing mill or scale breaker.

Camera No. 2 was located on the soaking pit balcony above the mill floor. This showed the slab which now becomes a bar, leaving the last roughing stand and entering the delay table area just ahead of the finishing stands.

Camera No. 3 was located on the control balcony to show the speed control house for the three slab heating furnaces.

Camera No. 4 was located in the coiler area on the balcony of the bar mill overlooking the runout table from the last finishing stand and the two down coilers.

Prior to the actual installation of television cameras at the mill, tests were conducted to determine picture quality with respect to the amount of available light. Also considered were the effects of heat and iron dust on equipment operation.

Preliminary tests revealed the need for additional lighting at each camera location, in the order of 15,000 watts. We should like to point out that the additional lighting was, for the most part, only necessary to give the high degree of picture detail necessary for display purposes. To determine "cobbles" and other troubles in the mill, light from the hot slab and surrounding areas was usually sufficient.

Some difficulty was experienced in infra-red radiation from the slab which caused video overload and a severe contrast problem. Varying degrees of infra-red filters over the camera lens helped the situation, but the final solution was in critical camera placement. This was a compromise that resulted in surprisingly good background detail and a well defined picture of the slab.

In all instances, the excessive heat had no detrimental effect on the camera equipment.

Iron dust did not cause any equipment failures during the trial tests, however, considerable dust did accumulate in all of the camera equipment used in the mill which probably would constitute a hazard over a long period of time.

It can be seen from Figure 1, the equipment schematic, that the video signal from each camera location is transmitted over 75-ohm coaxial cable to the central switching location in the mill area. Each camera cable remains terminated until switching, at which time it is connected to the 75-ohm input of a telephone company video clamper-amplifier.

Due to the comparatively short lengths (500 ft) of coaxial cable in the camera transmission path, no equalization is provided on these circuits.

Camera switching is controlled over telephone cable pairs from the auditorium location which necessitates the sequence relay operation illustrated in Figure 1. Vertical syncronization between camera chains is by the power line only, and vertical disturbance during switching will not be noticeable.

Video transmission from the Ford Rouge plant to the viewing auditorium is over a standard broadcast quality television circuit (4MC Bandwidth). This circuit is made up of two microwave links and an equalized wire line circuit. Two microwave links are necessary due to restrictions in the direct line-of-sight path. The

INDUSTRIAL TV-2-WAY RADIO

wire line circuit utilizes ordinary paper-insulated cable pairs and predistortion is employed to eliminate troublesome impulse-type noise.

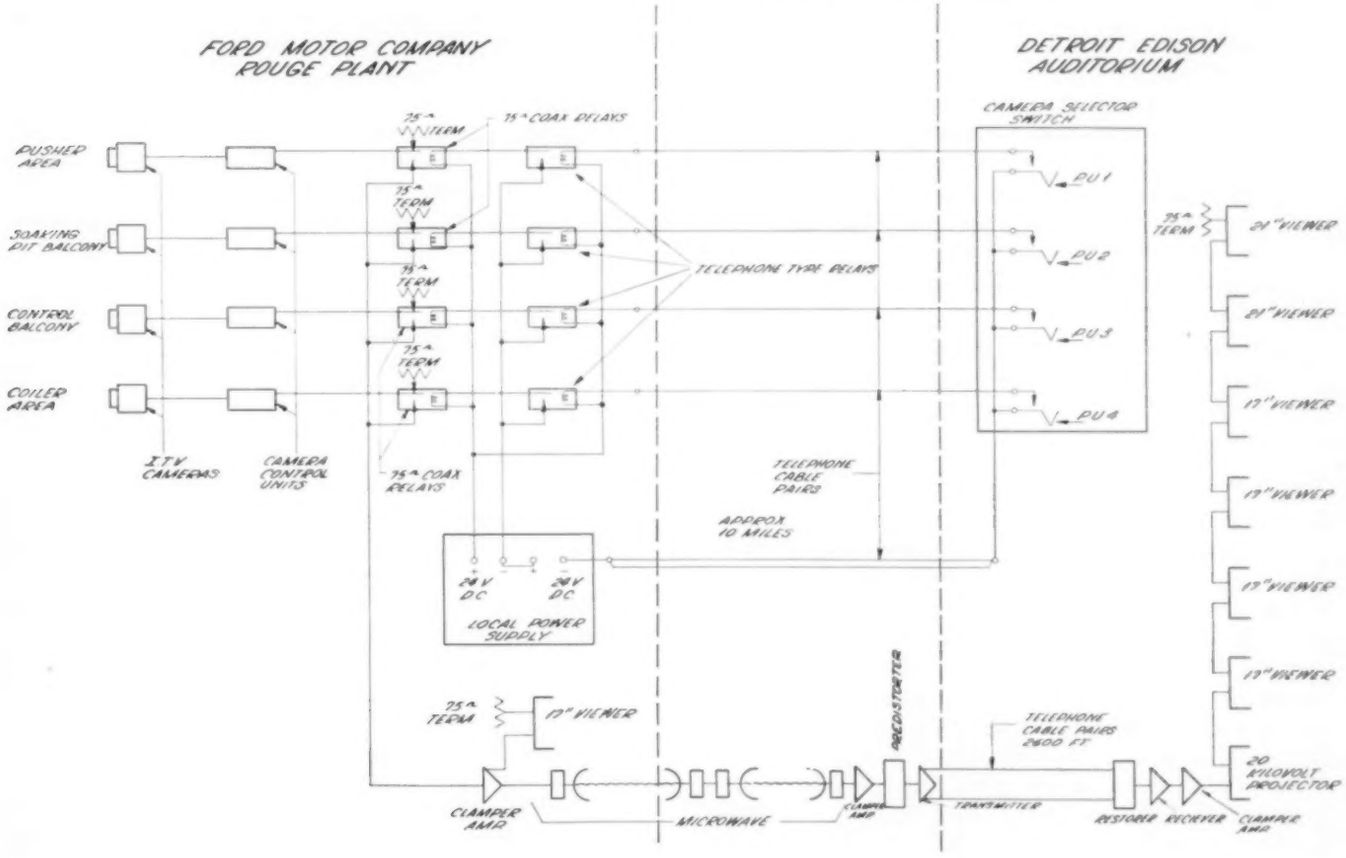
At the Detroit Edison Auditorium, the wire line circuit amplifiers are terminated in four 17-in. viewers, two 21-in. viewers and a 20-kv television projector. To add a feeling of presence, sounds from the mill were transmitted to the auditorium public address system via a standard telephone company audio channel.

On the platform there was a control desk, which had four push buttons, each one associated with one camera which made it possible to select for viewing any one of the pictures picked up by the cameras.

Thus, by showing the views or pictures picked up by the cameras in their proper sequence, one can follow the hot slab from the furnace into the roughing stands, all the way through the delay table area, through the finishing stands and out onto the runout table and into the down coilers. This is mentioned particularly, because the operator at the controls of the hot strip mill finishing stands can see only what is immediately in front of him and for a short distance to each side. Ordinarily the glow of the hot slab is the best indication he has that a slab is coming through the roughing stands until it actually has started through from the last stand.

It is quite logical to suppose that a series of viewers could be mounted on the master control desk so that the operator could, at a glance, see any part of the hot strip mill operation, and in the case of a breakdown, immediately shut down the mills to minimize damage to

Figure 1 — Schematic wiring diagram for industrial TV demonstration.



mill equipment. Further, if cameras were permanently focused on each viewer, it would be possible to photograph the breakdown and record the time and date for record purposes.

A duplicate set of monitors could be installed in the office of the superintendent of maintenance so that he also would be aware of the breakdown and take necessary action.

Another development that might eliminate expensive control balconies would be to place the controls in a clean, well-ventilated atmosphere such as the motor room and by using a series of self-indexing cameras follow the slab every foot of the way from start to finish on TV viewers.

For the actual demonstration, a slab, 48 in. wide, 5¼ in. thick and 192 in. long, weighing about 11,500 lb was run through the mill. From the entry end of the slab heating furnace, with three heating furnaces operating, a hot slab is ready to drop onto the roll table every one and one-half minutes.

DISCUSSION

PRESENTED BY

JOHN E. RUSSELL, General Foreman, Hot Strip Mill, Steel Division, Ford Motor Co., Dearborn, Mich.

ROY HEAD, Radio Engineer, Michigan Bell Telephone Co., Detroit, Mich.

IRVING ROZIAN, Supervisor, Process Research & Development, Steel Division, Ford Motor Co., Dearborn, Mich.

WILLIAM SCHARFENAKER, Masonry Superintendent, Steel Division, Ford Motor Co., Dearborn, Mich.

FRED J. JOLLY, Power Sales Engineer, Detroit Edison Co., Detroit, Mich.

NEIL C. YOUNGS, Assistant General Sales Manager, Michigan Bell Telephone Co., Detroit, Mich.

F. BRUCE BEVELHEIMER, Power & Fuel Engineer, Steel Division, Rouge Plant, Ford Motor Co., Dearborn, Mich.

HOWARD JONES, JR., Representative, Davis Firebrick Co., Detroit, Mich.

BERNARD P. FANTONE, Electrical Engineering Staff, United States Steel Corp., Gary Works, Gary, Ind.

John E. Russell: Is an application such as this being used anywhere in the steel industry today?

Roy Head: Yes. I cannot name the steel mills exactly, but I do know of five or six installations. The Bell System has one on a hot strip mill in Illinois, and I know there are other private applications.

Irving Rozian: What is the cost of a single camera-viewer pair and then the cost of a system having a central synchronizing unit and say four or five viewers and cameras?

Roy Head: As far as cost goes from a telephone company standpoint, we lease the equipment. Actually the cost for each application would be different. There are many different types of equipment and we utilize that which best fits the application. It runs approximately $2000 to $5000 for a camera, viewer, and associate equipment.

William Scharfenaker: Would you elaborate on the transmission arrangement between here and the plant?

Roy Head: We are using microwave from the mill to the Rotunda, microwave from the Rotunda to the Bell Building, and equalized telephone cable from the Bell Building to the Edison Auditorium.

William Scharfenaker: You say microwave, you mean a tube?

Roy Head: No. This is a microwave relay system, the same type that is used to transmit television programs from specific locations to broadcast transmitters.

William Scharfenaker: You are actually broadcasting, then?

Roy Head: Yes, it is strictly directional from one point to another.

Irving Rozian: How many individual tube stages does the signal go through from the camera through switching, and so on?

Roy Head: Oh, I would guess close to a hundred tube stages. A problem arose initially, we thought we would transmit directly from the Ford Mill right to the Telephone Company building and we ran into smokestacks, so we went from the mill to the Rotunda to the Bell Building.

Member: I would like to direct this to Mr. Russell. Are there other applications at Ford in addition to those we have seen here, where you can use a similar TV arrangement?

John E. Russell: I understand an application similar to this, which we were interested in and we are still interested in, is being used successfully to utilize available manpower and take into account locations the man cannot see. That is the immediate thing. The mill is roughly a half mile long, so there may be similar applications for such equipment. Where a man is approximately 100 to 200 ft away from the particular installation mill or piece of equipment he might control, such as the roughing stand shown by Camera No. 2, this equipment would be highly desirable. He has no way of knowing except by his long years of experience that when the glow hits the wall to the west, the bar is out of the mill.

If the bar does not leave the mill and goes into the sewer, which happens on rare occasions, an installation like this might possibly minimize damage and downtime.

Mr. Head, there is one thing I would like to ask. You have seen our mill and have become familiar with our inherent problem of oxidation; and we also have trouble with our electrical equipment due to corrosion and dust. Is there anything you could tell us regarding protective equipment or maintenance problems we might expect if we get the workers to rely on an installation like this? Would we run into tremendous maintenance problems as far as equipment being on and off? What sort of effect will our dust have on this particular type installation?

Roy Head: The exposed equipment, the camera or viewers, such as you see up here might be a problem. I do not know what degree of oxidation you have in there, but the cameras can be equipped with what we

call weatherproof housings and it amounts to filtered air, from a forced-draft filter. I have not been out there long enough to tell you what you would run into on that sort of situation.

John E. Russell: Does it also have protection as far as heat?

Roy Head: Yes. It has a certain cooling effect. The fact is, cameras without weatherproof housings are able to stand terrific heat by themselves.

Since we have been in the Ford rolling mill, and we have been in there about two weeks off and on with equipment, we have not had a failure that we can attribute to oxidation or to dust or whatever you want to call it. But we have noticed that dust does collect in some of the equipment. We have different types of equipment in use, some with filters and some without, but I do not think it would be too much of a problem, because in most installations you could protect the equipment.

William Scharfenaker: There are locations. I am thinking about the hot furnace right now, where the flames are difficult to observe. Occasionally, burners get fouled and the flame gets out of hand without being seen. Would it be practical to rig up a camera with some sort of lens that could withstand considerable heat so that you could observe what goes on inside a furnace?

Fred J. Jolly: Unfortunately, I am not in a position to give all the details, but at our St. Clair plant we have a television camera to observe the flame in the furnace. I have seen the picture but not the location of the camera or what protective facilities it has; but, judging from the picture we get on the screen, that camera must be quite close.

Neil C. Youngs: I have read about, but not seen, a series of mirrors which allow the camera to be sufficiently far from the source of the heat to protect it from danger, yet give a picture.

Irving Rozian: The image Orthicon tube that is used for pick up, industrial TV as well as commercial, has much better infra-red vision than the human eye, therefore you can put a visible light filter in front of it and see through a flame quite well.

F. Bruce Bevelheimer: I think I can answer part of Mr. Scharfenaker's question. About four years ago, we installed a closed circuit TV setup in our plant. The camera tube is quite sensitive to infra-red and did show our burner flame, and the slabs in the furnace.

Member: I would like to elaborate on that subject a little bit. The Carborundum people have a furnace and camera attachment whereby they can observe the melting of silicon material. I think if a camera can do it, it can be televised.

Neil C. Youngs: In a lot of these cases the problem is one of sitting down and studying the individual problems. Most of them can be solved.

Howard Jones, Jr.: I might point out how this is done in the brick plants. There are several different types of water-cooled and air-cooled windows available picturewise, cut down to 49 degrees on the inside and about 130 degrees on the outside, and the camera can be mounted against these windows. From the standpoint of keeping the lens on the inside clean, there is air that pulls the dust away, plus the fact that you can put screening in there.

Bernard P. Fantone: This interesting and comprehensive demonstration shows that TV can be successfully applied almost anywhere in a steel mill.

Our sister plant, the Gary Sheet & Tin Mill, has been using an industrial TV installation during the past two years at its 80-in. hot strip mill. A monitor on the desk of the operator (who is stationed on the delivery side of the last finishing stand) enables him to observe the movement and condition of the strip, as it travels beyond an intervening cloud of steam on its way to the coiler.

Successful tests have been performed with industrial TV for remote observation of blast furnace mud gun operation at Gary Steel Works. Consideration is being given to the possible use of TV for the study of flame characteristics and refractory conditions inside open hearth furnaces.

Another prospective application at Gary Steel Works is in the remote observation of the final sinter product as it drops off the long sintering machines. And, of course, the applications shown here tonight will definitely be looked into.

WANTED!

There is constant demand for copies of "The Modern Strip Mill," published by the Association of Iron and Steel Engineers. If your copy is not in use please get in touch with us.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

The President's Message

This year marks the 50th Anniversary of the Association of Iron and Steel Engineers. Space does not permit enumerating the many successful activities and notable accomplishments of the Association since its formation in 1907. Credit, however, must be accorded to those past officers and members whose efforts down through the years have made the Association of today.

At present, the steel industry is faced with the complex problem of narrowing the gap between steel demand and supply. This involves the building of new plants and the modernization of old plants. The members of our Association are in an ideal position to make valuable contributions toward the solution of this problem because of their knowledge of requirements and their years of experience in such programs.

The success of the Association since its formation presents a definite challenge to the members and officers of today. Let us all view 1957 not only as a Golden Anniversary, but also as a golden opportunity for further effort and accomplishment by the Association for the steel industry which it serves.

J. D. O'ROARK

President, AISE

James D. O'Roark

President, 1957

Association of Iron and Steel Engineers

JAMES D. O'ROARK was born in Broadway, Va. He was graduated from Ohio State University in 1926 with a degree in electrical engineering. After graduation he was employed in the student engineering training course and test floor from 1926 to 1930 at Westinghouse Electric Corp.'s East Pittsburgh works. He has been employed by Weirton Steel Co. from 1931 to the present date as electrical field engineer, electrical foreman of strip steel and sheet mill dept., assistant electrical superintendent, electrical superintendent, and assistant manager department of service and maintenance, the position he now holds.

LEONARD LARSON
First Vice President

EMIL KERN
Second Vice President

S. C. READ
Treasurer

NEWLY ELECTED OFFICERS AND DIRECTORS

LEONARD LARSON was employed as a draftsman at Jones & Laughlin Steel Corp., and Carnegie Steel Co. in Pittsburgh, Pa., from 1913 to 1917 while attending night school at Carnegie Institute of Technology. In 1917 he moved to Massillon, Ohio, as a draftsman for Central Steel Co. He was appointed chief draftsman in 1918, and assistant chief engineer for Central Alloy Steel Corp., in 1926, in a merger between Central Steel Co., and United Alloy Steel Corp. In 1929 he was appointed chief engineer, and served in this capacity for Central Alloy Steel Corp., and Republic Steel Corp., after a merger in 1930 until 1939 when he was transferred to the Cleveland district as district chief engineer, the position he now holds. From 1933 to 1936 he spent about one year on special open hearth work for the corporation, and about two years in the operating department as divisional superintendent at the Massillon steel plant.

EMIL KERN was graduated from the University of Stuttgart, Germany, in 1926 and began his career as a machinist and designer with Mesta Machine Co. in 1930. He became associated with Reynolds Metals Co., as chief mechanical engineer in 1945, and joined the Allegheny Ludlum Steel Corp., Pittsburgh, Pa., as chief engineer the following year. In May 1949, he was elected vice president in charge of engineering of the Allegheny Ludlum Steel Corp.

S. C. READ attended Purdue University and the University of Michigan. He graduated from the University of Michigan with a degree in mechanical engineering, and later received a master's degree in metallurgical engineering at Carnegie Institute of Technology. Mr. Read started to work for Jones & Laughlin Steel Corp., Pittsburgh, Pa., in 1924 as assistant superintendent, power department at the South Side works. In 1938, he was made master mechanic of rolling mills, Pittsburgh works. He was appointed superintendent of blooming department and rolling mills, Pittsburgh works in March 1946, and named manager of maintenance for the entire corporation in November 1947. Mr. Read has since been made director, construction and maintenance for Jones & Laughlin Steel Corp.

C. E. PRITCHARD was born in Pittsburgh, Pa., and was graduated from Carnegie Institute of Technology in 1932. He first worked for the Atlantic Refining Co. where he stayed until 1937, at which time he entered the steel industry. He then became employed in mill maintenance at the Warren district of Republic Steel Corp., with later appointment as district lubrication engineer. In 1941 he was promoted to chief lubrication engineer of all Republic Steel's operations with headquarters in the general office in Cleveland. In 1951 he joined the Alan Wood Steel Co., serving as superintendent of finishing mills, and the following year was promoted to superintendent of mills, including all rolling mills and a cut nail mill, the position he now holds.

HARRY L. JENTER was born in Trenton, N. J. He joined the American Steel & Wire Division's Trenton works in 1917 as a draftsman, and for the next few years alternately worked for the division and attended college. In 1926 he was graduated from Syracuse University with a degree in mechanical engineering and transferred to the Cleveland office. In 1928 he was made assistant foreman at the Newburgh Wire works. Mr. Jenter was transferred to the Cuyahoga works cold roll strip department in 1932, and in 1934 was made general foreman. He became assistant superintendent of the works in 1935, general superintendent in 1939, and in 1942 transferred to the headquarters office as assistant to the vice president of operations. He resumed the post of general superintendent of Cuyahoga works a year later, was made chief engineer in 1950, assistant district manager in 1952, and manager of operations Cleveland District, American Steel & Wire Division, U. S. Steel Corp., in 1953. In 1956, he became vice president of operations.

C. W. BRUCE was graduated from Case Institute of Technology in mechanical engineering in 1933. He started in the steel business in the blooming mill at the Corrigan-McKinney Steel Co., and in 1934 transferred to the combustion department. After the merger with Republic Steel Corp. in 1935, he continued in the combustion department until 1942, at which time he was transferred to the Chicago district of the Republic Steel Corp., as combustion engineer. In 1947 he was made assistant chief engineer of the Chicago district, and has since been promoted to the position of chief engineer, Chicago district.

C. E. PRITCHARD
Secretary

H. L. JENTER
Director-at-Large

C. W. BRUCE
Director

G. R. CLARKE
Director

E. F. DONATIC
Director

F. A. GARMAN
Director

G. H. GREENE
Director

ASSOCIATION OF IRON AND STEEL ENGINEERS 1957

G. R. CLARKE started work in 1916 at the Alton plant of the Laclede Steel Co. He became blooming mill superintendent in 1923, and later became superintendent of the 10-in. mill, 8-in. mill, and billet yard. In 1945 he became plant superintendent of the Alton plant. In 1951 he was made assistant general manager of both the Alton and Madison plants, and since December 1954 has served as general superintendent of the Laclede Steel Co.

E. F. DONATIC was born in Chicago. While studying electrical engineering at the Illinois Institute of Technology, he worked as an electrical apprentice at Interstate Iron and Steel Co. In 1934, he became general foreman of the electrical department, when the company went under the management of Republic Steel Corp. In 1943 Mr. Donatic was promoted to electrical superintendent. In 1946 he joined Kaiser Steel Corp., as assistant superintendent of maintenance. Later he was made superintendent of maintenance, and in 1950 became division superintendent of services. He was promoted to assistant general superintendent, services, in 1953, and general superintendent in January, 1957.

FLOYD A. GARMAN was born in Alliance, Ohio, July 4, 1904. He attended Mount Union College and Case School of Technology. He is a licensed professional engineer. After several years employment with Alliance Machine Co., Morgan Engineering Co., Aetna-Standard Engineering Co. and United States Navy, he joined the American Steel & Wire Co. in 1935 as a draftsman, was named works engineer of the South Works, Worcester, in 1944, and in 1947 was made superintendent of engineering and maintenance. In 1949 he was named projects division engineer in Cleveland, became assistant chief engineer in 1950, and chief engineer in 1952.

G. H. GREENE graduated from Clemson College in 1926 with a degree in electrical engineering and at that time started work in the rolling mills of Bethlehem Steel Co. He was transferred to the Lackawanna plant in 1927, working in the rolling mills, construction, electrical and engineering departments until 1946. In 1946 he was promoted and moved to the Steelton plant as chief engineer. In 1949 he became chief engineer of the Johnstown plant, and in 1952 was made assistant to the general manager.

A. G. HENRY attended school at Duffs Business College and took Purdue extension courses. He has been employed by the United States Steel Corp., at various subsidiaries, for approximately 35 years. In 1923 he was transferred to the lap weld and seamless departments, National Tube Co., Gary, after spending five years in the hot draw department, Christy Park Works, National Tube Co., McKeesport. From 1933 to 1937 he was foreman and assistant superintendent of construction at the Gary Sheet and Tin Mill, Gary, and in 1937 went to Fairfield Tin Mill, Tennessee Coal & Iron Division, Fairfield, as assistant superintendent and subsequently has been promoted to superintendent of maintenance.

GEORGE H. KRAPF was born in Pennsylvania in 1908. He went to school at Carnegie Institute of Technology where he studied metallurgical engineering. From January 1928 to 1938 he worked for Firth Sterling Steel Co., in the carbide research laboratory. In 1938 he went to work at the Irvin works of the United States Steel Corp., as assistant superintendent, cold reduction department and assistant superintendent of the hot strip mill until 1942. From 1942 to 1950 he worked as division superintendent, power production department at the Homestead works of the United States Steel Corp. He then went to the Pittsburgh office of the United States Steel Corp. as a consulting engineer power and fuel. In 1952 he became assistant chairman, inter-division committee on manufacturing, engineering, and raw materials, and in 1953 he became technical assistant power and fuel—staff of the vice president of manufacturing—general. Since 1954, he has been division superintendent, power production at the South works of the United States Steel Corp.

C. S. LAMBERT was born in 1892 in Daley, Pa., and attended public schools at Johnstown. In 1906 he started working for United States Steel Corp., at Johnstown and in 1911 moved to the Cambria Steel Co., where he worked as timekeeper, inspector, and roll mill foreman. He went to work for Youngstown Sheet and Tube Co. in 1937 as assistant superintendent of merchant mills, and since 1945 has been superintendent of the merchant mills.

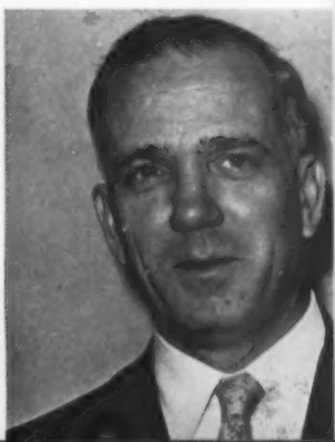
KENNETH E. LEWIS was born in Clio, Iowa, in 1911. In 1916 his family moved to Detroit where he attended school. He was graduated from Michigan College of Mining & Technology with B.S. in Metallurgy and Engineering. After graduation he joined Rotary Electric Steel Co., in the metallurgical

A. G. HENRY
Director

G. H. KRAPF
Director

C. S. LAMBERT
Director

K. E. LEWIS
Director



D. C. McCRADY
Director

R. G. NOLAN
Director

W. C. SCHULZ
Director

J. H. STONE
Director

department progressing through various jobs. He is now supervisor of quality and processing.

D. C. McCRADY was born in Montreal, and was graduated from McGill University as an electrical engineer in 1936. He then spent two years on the General Electric Test Course. Upon completion of this course he worked several years for Canadian General Electric as sales engineering in the mining districts, then spent six years as application and field engineer on steel mills and mining equipment. In 1947 he joined the Steel Co. of Canada as general foreman, electrical department, became assistant superintendent in 1948, and superintendent electrical department in 1950 in charge of engineering, construction, shop, and maintenance at the Hamilton Works.

R. G. NOLAN was born in 1921. From 1942 to 1946 he served in the air force and OSS. He graduated as an electrical engineer in 1950 from Washington University and immediately went to work for Granco, a subsidiary of Granite City Steel Co., as project engineer. Since 1951 he has been electrical engineer for Granite City Steel Co.

W. C. SCHULZ was born in Cleveland, Ohio, in 1895. He attended Lehigh University, graduating in 1917 when he enlisted in the United States Navy. In 1920, after being discharged as an ensign, he joined the Bethlehem Steel Co., Steelton plant, coke oven department, as a chemist and was promoted to foreman. In 1924 he joined the Perry Iron Co., Erie, Pa., as assistant superintendent of coke ovens. In 1929 he returned to the coke oven department of Bethlehem's Steelton plant as assistant superintendent. He was later advanced to assistant to general manager, and is now superintendent of general mechanical department of the Steelton plant.

JOHN H. STONE is a native of Belmont, Mass., attended schools there, and at Stonybrook Prep School in New York. He entered Brown University in 1938. In 1940, before finishing at Brown, he joined the United States Navy, spending five years in active sea duty. In 1945 he joined the Carnegie Illinois Steel Corp., as personnel assistant, and became junior industrial engineer in 1946. During 1945–46 he attended night school at the University of Pittsburgh, and in 1946–47 Youngstown College. In 1947 he joined the Youngstown Sheet and Tube Co. as industrial engineer, became general foreman of the merchant mills at Struthers in 1950, was appointed assistant superintendent of the merchant mills in 1952, was transferred to the cold strip department as assistant superintendent in 1954 and was made assistant superintendent of the seamless tube mill finishing department at the Campbell Works in 1955. In 1956, he became assistant superintendent, cold strip mill.

GEORGE W. TESKEY, JR., was born in San Francisco, attended St. James School for Boys, Sacred Heart College, San Mateo Junior College, and the University of California. In 1929 he entered the employ of the Bethlehem Pacific Coast Steel Corp., South San Francisco Works, Metallurgical Department, serving as chemist, metallurgical observer, and open hearth melter-foreman. In 1939 he was appointed assistant superintendent, open hearth department, and in 1952 was made superintendent of the open hearth department.

E. L. TINDALL is a native of Colorado Springs, Colo. He attended the University of Illinois graduating as a mechanical engineer in 1929, and then entered the employ of the Public Service Co. of Northern Illinois as gas engineer. In 1930 he joined the South Works, Carnegie Illinois Steel Corp., as combustion engineer, and in 1939 became superintendent of fuel and combustion. In 1941 he was transferred to the staff of chief engineer at Pittsburgh as steam, fuel, and power engineer. From 1942 to 1946 he served in the Engineer Corps, U. S. Army rising from 1st Lt. to Lt. Col., serving most of this period in charge of the design of military installations in the European theatre of operations. In 1946 he returned to his previous job at Pittsburgh, and in 1947 he was made chief engineer of the Edgar Thomson Works. In 1948 he was promoted to district engineer, Pittsburgh district of the Carnegie Illinois Steel Corp., and in 1950 he was promoted to chief engineer, operations of the Carnegie Illinois Steel Corp. In 1951 he became chief plant engineer—manufacturing division of the United States Steel Corp., and in 1952 chief engineer—manufacturing division. In 1953 his title was changed to chief engineer—steel. In 1956, he was named assistant vice president—engineering.

DONALD E. WHITEHEAD has been actively engaged in petroleum engineering for twenty seven years. His oil career began in 1929 with oil producers and included service with the Sun Oil Company's Pittsburgh region sales, as division engineer, Gulf Oil Corp., Toledo, Ohio, and as division engineer, Tide Water Associated Oil Co.'s New York Div. He became associated with the oil consumers as lubrication engineer of Homestead Works of Carnegie Illinois Steel Corp. in 1941. Two years later he became general lubrication engineer of the entire Carnegie Illinois Steel Corp. In 1949 he joined the Crucible Steel Co. of America heading Crucible's petroleum and painting activities. During 1956 Crucible's petroleum and painting standards programs were expanded to include standards and quality control of additional commodities which Mr. Whitehead now directs as Crucible's materials & standards engineer. He was born in Bellevue, Pennsylvania, attending elementary and high school there, Culver Military Academy, Carnegie Institute of Technology, and attended a number of extended courses in petroleum refining. He has participated in several co-operative research programs which were singular for their pioneer contributions in the rapidly expanding field of oil additives.

R. T. WINTERRINGER was graduated from Purdue University as an electrical engineer in 1933. In that year he joined the Republic Steel Corp., electrical department, became electrical construction foreman in 1939, general foreman electrical department in 1946, and in 1948 became assistant superintendent electrical department at Chicago, Ill.

G. W. TESKEY, JR.
Director

E. L. TINDALL
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Construction and Application of Draft Recorder on a 44-in. Blooming Mill

. . . . installation of draft recorder on 44-in. mill showed areas where improvements might be made . . . . it seems possible to reduce number of passes on bloom ingots of plain carbon grade without affecting surface quality, thus increasing production . . . . standardization of draft practice might also decrease maintenance costs . . . .

By

N. S. WELLS,

Application Engineer

and

J. SIBAKIN,

Metallurgist

Steel Co. of Canada

Hamilton, Ontario, Canada

PART I. DESIGN AND CONSTRUCTION

▲ *Introduction*—A previous paper (1)* by R. D. Hindson and J. Sibakin, described an investigation made on the 44-in. mill on the influence of soaking pit practice on metal plasticity. At the same time, the optimum drafts for ingots of various sizes with regard to the mill drive motor load were also studied. Investigations of this nature required extensive records of mill load currents and drafts, rolling times, etc. Prior to this study by the metallurgical department, the writer had been engaged in the derivation of work curveson this mill for checking the horsepower requirements for a new blooming mill. In all of these investigations, synchronized measurements of mill motor current and draft were required. It was obviously desirable to have an instrument of simple form capable of reproducing a synchronized record on a single chart of three or four major mill characteristics. Preliminary ideas on a primitive form of draft recorder were first investigated in October 1954. Based on the results obtained, it was possible to specify in some detail the requirements for an adequate form of draft recorder capable of producing records which would require only the minimum of interpretation.

A record of mill draft alone is meaningless since a roll movement from a slabbing to an edging pass would have to be interpreted as a working draft. This would be too large a movement to reproduce accurately on a recorder so a maximum drafting range would have to be specified. There would then be no record at all of the draft on the ingot entering pass. It is therefore necessary to record mill roll opening. Dummy passes must also be detected —rolling load is the only criterion for this—hence mill drive motor amperes must be recorded. This also provides an indication of steel rolling temperatures for identical drafting schedules. The complete draft recorder therefore must provide a simultaneous record of draft (inches) roll opening (inches) and rolling load (amperes). The main components of the draft recorder producing these values are shown in Figure 1.

Design—A digital counting system was adopted in order to obtain an accuracy of ±0.1 in. for the draft reading. A rugged contact device utilizes a simple commutator which short circuits two carbon brushes on its circumference every 0.1 in. of movement of the screws, thereby producing the necessary counting pulses. This contact device is mounted directly in the drive for the mill fractional inch indicating dial located on the east side of the mill housing. Details of this unit are shown in Figure 2. Roll position is derived from a 10-turn potentiometer chain driven through a suitable reduction unit from the mill inch indicating dial located on the west side of the mill housing. This unit is shown in Figure 3. The accuracy of the roll position record is ±1/4 in. The third value to be recorded is the main motor armature current which is derived from the normal main bus ammeter shunt.

The pulses produced by the contact device on the east screw operate heavy duty telephone uniselectors. Two 25-step 5-bank uniselectors are used in cascade since a maximum draft of 3.6 in. is recorded. The actual chart maximum is 3.5 in. and the 3.6-in. position is the limit usually denoting a high lift on the mill rolls. These uniselectors also function as a direct digital to analog con-

* Numbers refer to Bibliography at end of article.

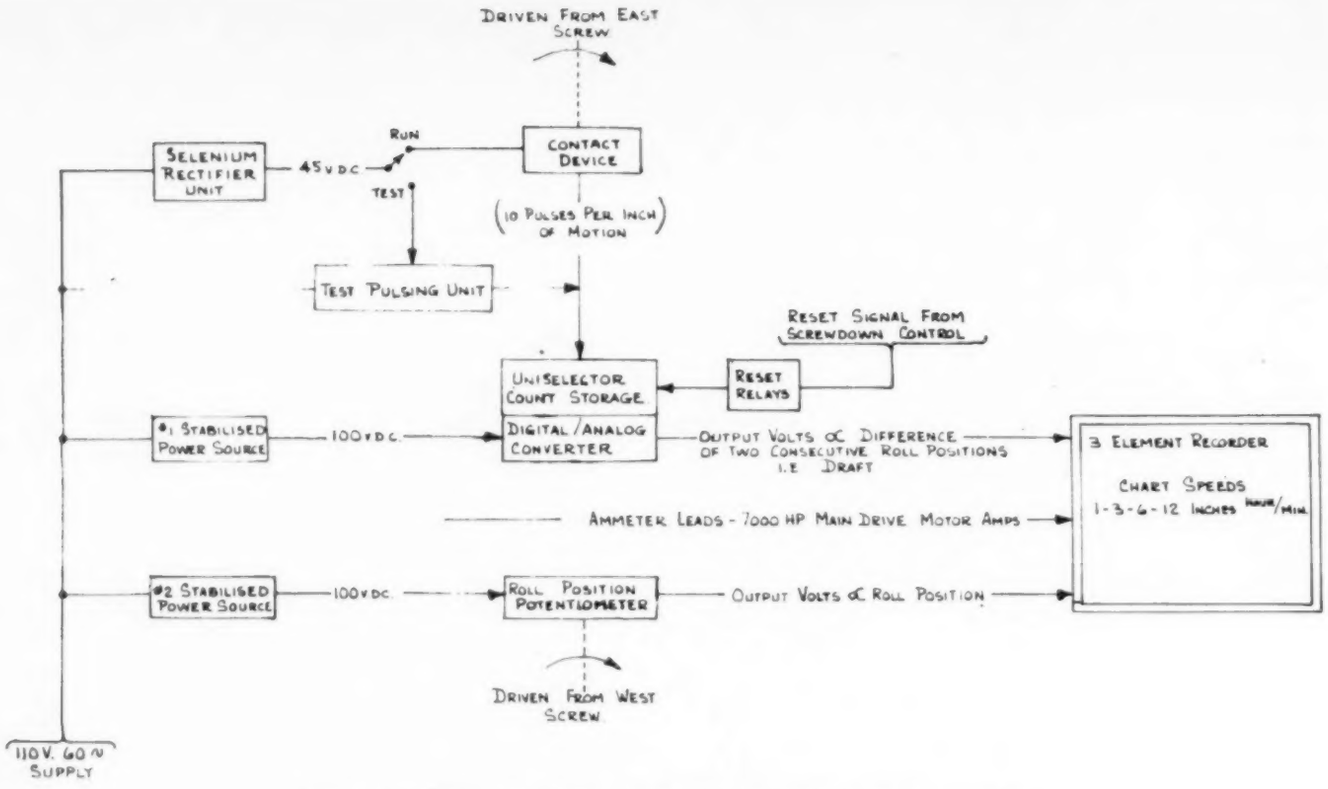


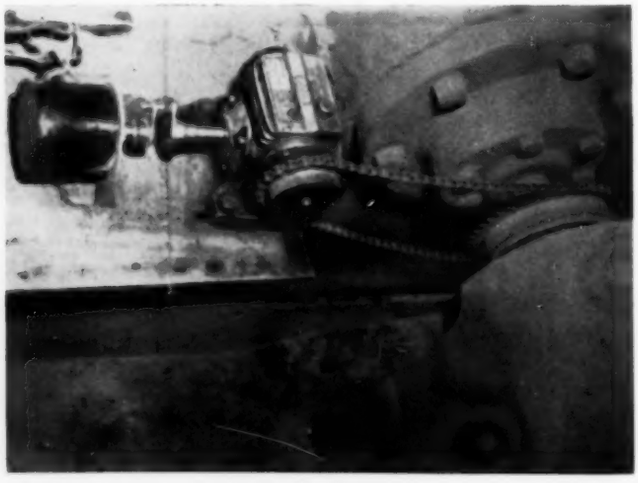
Figure 1 — Schematic shows main components of draft recorder.

version system. One bank of each uniselector is part of a potentiometer with the individual contacts providing discrete points on a precision resistance chain fed from a stabilized power source (Figure 1). A staircase voltage is derived giving a voltage output proportional to wiper arm position on the uniselector and hence roll movement up to 3.6 in. An oscillograph of this output voltage for two different pulse rates is shown in Figure 4. The fact that the output of this unit is unidirectional emphasizes the need for a record of roll position. As the draft unit has to indicate the difference between two consecutive roll openings, it is necessary to reset the uniselectors to zero immediately roll movement has ceased. A signal from the screwdown drive motors control actuates reset relays which "home" the uniselectors to zero at high speed—this is a normal function of telephone uniselectors to zero at high speed—this is a normal function of telephone uniselectors. The complete draft signal assembly is shown in Figure 5.

Construction—The draft signal chassis incorporates the rectifier unit supplying the uniselector relays coils, the reset relays, the two uniselectors, a total time meter and the test pulsing unit. The latter consists of a small electronic unit producing pulses, the rate of which can be varied over a wide range. The output operates a relay which can be switched into the circuit to replace the contact device on the mill. This unit is intended for test purposes only, and is used to check the uniselector

Figure 2 — This contact device is mounted on the east screw.

Figure 3 — View shows roll positioning device on west screw.



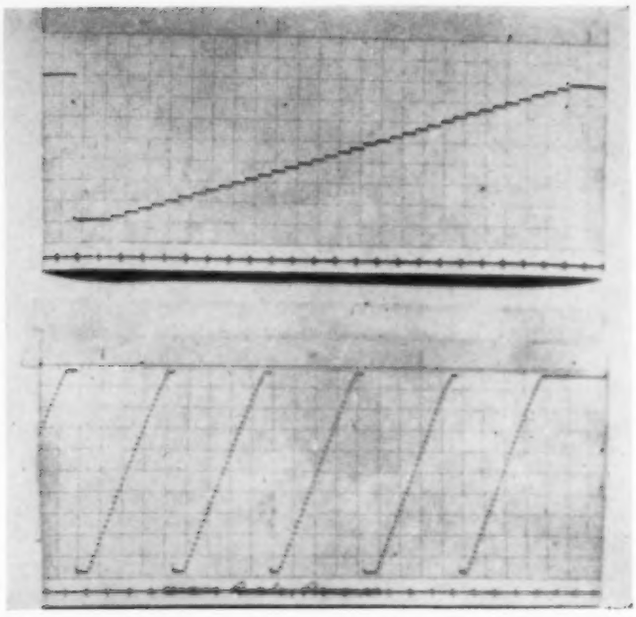


Figure 4 — Staircase voltage output from draft signal unit.

operation at various pulse rates and also the calibration of the draft section of chart. The output traces shown in Figure 4 were obtained using this test unit. The two uniselectors are mounted in a dust tight enclosure with a front observation window. The actual uniselector assembly is shown in Figure 6. It will be noted that the two uniselectors are assembled as an integral unit with all outgoing leads terminating in a single 8-pin plug. This complete assembly can be quickly unplugged and replaced with a stand-by assembly when necessary. Similarly all other relays on this chassis are of the plug-in type. The total time meter which is running when the chassis is switched on was installed to enable a log to be kept of component failures and reliability in general. The uniselectors are making an estimated 2 x 10^6 steps per week.

The three element recorder is shown in Figure 7. It is an ink recorder and has rectilinear coordinates. This is important because of the necessity of exactly correlating the three records. The chart used is 12½ in. wide and each of the individual charts is 3½ in. wide. A fourth pen is available on this unit for use as an event marker. At present this is being used to provide indication of excessive loading on the flywheel set, and is operated by a position limit on the slip tank when the flywheel set speed is reduced by approximately 35 per cent.

The cubicle housing the complete unit is shown in Figure 8. The recording meter is housed at the top with the space at the rear of the meter being available for storage of new charts, ink, spare pens, etc. The draft signal assembly is mounted below it. The stabilized power sources are located on the next lower level, and the remaining space at the bottom is available for spares stowage.

Summary—This complete unit has been designed as a practical piece of mill instrumentation produced at a reasonable cost. It is always available for mill supervision purposes, e.g., an additional check on delays or inspection of conditions prevailing when mill equipment has been damaged. Also the ingot sizes, the number of ingots per hour, the number of passes per ingot are immediately accessible. It is now possible to check and compare the rolling techniques of different rollers.

Normal chart speed for mill supervision purposes would be 12 in. per hr. An example of this is given in Part II. However, new rolling schedules on standard ingots can always be checked on a single ingot basis by switching the recorder speed to 12 in. per min. Thus estimates of possible production increases can be studied without disturbing normal mill production. At this chart speed, clumsy ingot handling can be detected and a figure for the best possible rolling time derived. A major use for this unit is its application to mill investigations, and obviously comprehensive mill time studies can be readily accomplished.

The charts obtained are not quite complete in detail

Figure 5 — Complete draft signal assembly is ruggedly built.

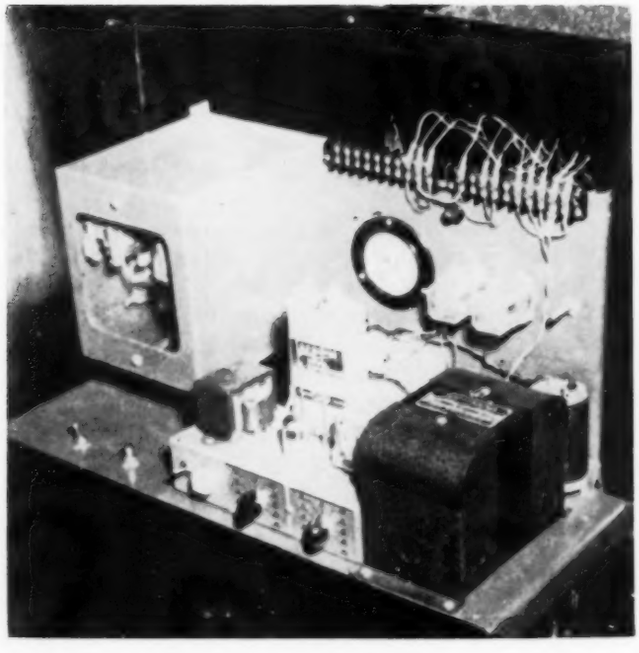
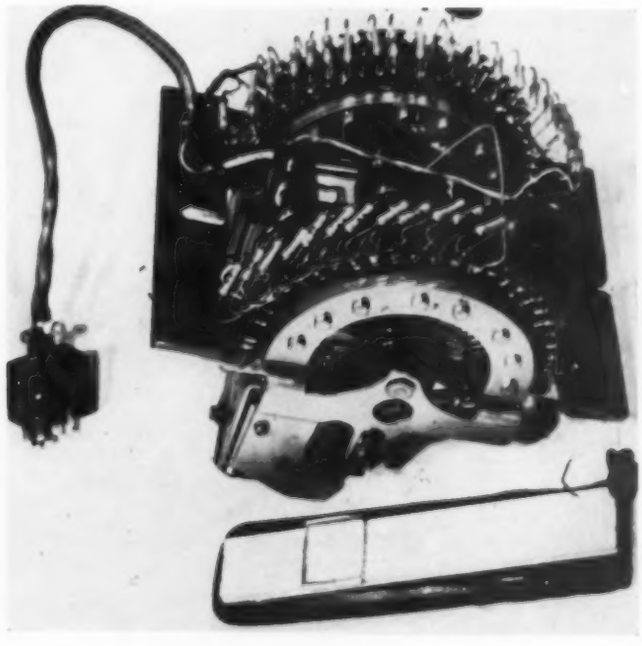


Figure 6 — Uniselector relays are assembled as an integral unit.



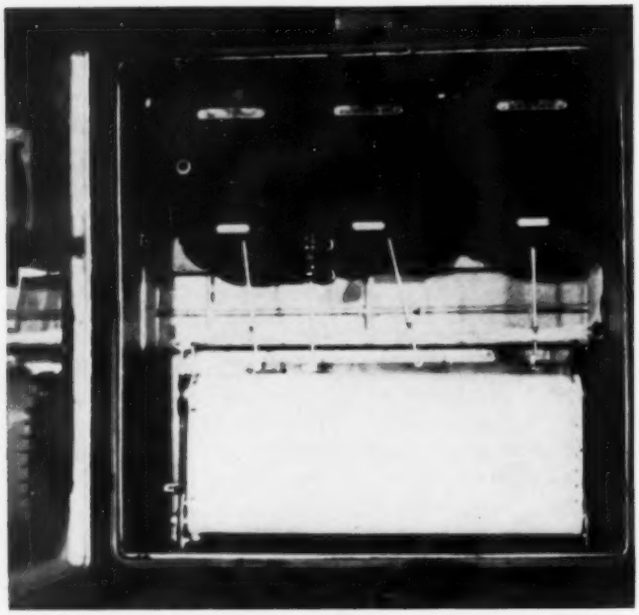


Figure 7 — A 3-element draft chart recorder is used.

as there is no indication of whether the pass has been made in the bull head or side passes. This can be troublesome in the case of blooms. If necessary, however, bloom position indication could probably be obtained by operating additional event markers from limit switches operated by the side guards to indicate whether the bloom is at the 5½, 10 or 14-in. pass. The draft signal system utilizing the uniselectors probably cannot be used on higher speed screws, i.e., above the present 260 in. per min. For high speed screws, an electronic digital to analog system would have to be used for draft measurement. In addition an alternative method of displaying the read-out signal may be necessary. Some work has apparently been done by the British Iron and Steel Research Association on measurement techniques using teleprinters[2] but these units would not appear to be capable of producing readily accessible results.

PART II. APPLICATION

The draft recorder on the 44-in. blooming mill at The Steel Co. of Canada has been installed to bring about improved quality and/or increased production while maintaining high quality. The three part roll chart shows the roll opening in in., the draft (or change in roll positions between settings) in in. (given in tenths of in.), and the mill motor loads in kiloamperes. A fourth pen will record any on-off operations.

The present chart speeds available are: 1, 3, 6, and 12 in. per min and per hr. A chart speed of one in. per min is excellent for detailed consideration of the rolling practice on individual ingots and heats. For a continuous control record, a speed of 12 in. per hr is very satisfactory.

Typical chart records are shown in Figures 9, 10 and 11. Figure 9 shows a record for five 22 x 24-in. big end up ingots. The thirteen passes are identified for the first ingot. Ingots 1, 2, 4 and 5 are quite uniform, but on the third ingot the roller missed his entry into the tenth pass, i.e., the 14-in. confined pass, and consequently had to spend 60 seconds squaring off the bloom before proceeding. Figure 10 shows two 28 x 45-in. slab ingots followed by three 27 x 53-in. ingots. The slabbing pass drafts in the 45-in. ingots are very uniform, but the drafts encountered in the 53-in. slabbing passes show considerable variation. A slow-speed record, 12 in. per hr, for routine control is shown in Figure 11.

Figure 8 — A cubicle houses complete recorder unit.

Many possible applications and benefits of the draft recorder, in a study of rolling practice, come readily to mind, and others will undoubtedly arise as familiarity increases. Some of these are:

1. A more uniform drafting practice from pass to pass and from ingot to ingot with resultant time savings.
2. A graduated drafting practice to lighter drafts on successive slabbing passes within a slab ingot to prevent undue temperature rise in the slip-tank resistance of the motor generator set.
3. The maximum safe drafts that may be taken without deterioration of quality or exceeding the critical mill load.
4. The effect of decreasing the number of passes on quality, rolling time, mill load, and power consumed.
5. The frequency of exceeding the safe mill load and the frequency and duration of excessive temperatures in the motor-generator slip-tank resistance.
6. Any mill motor acceleration with steel between the rolls.

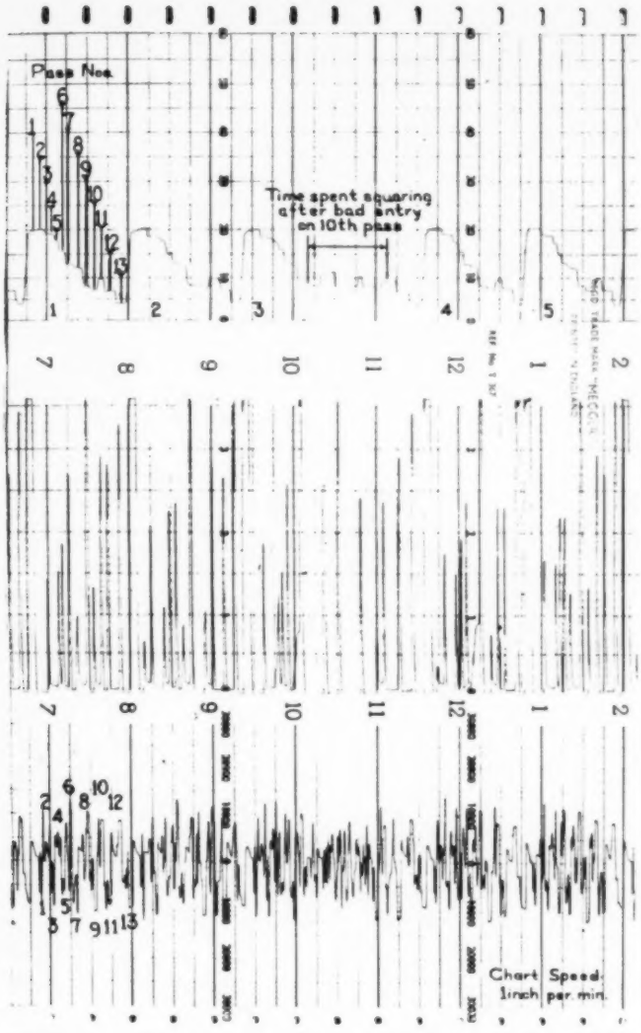


Figure 9 — Typical draft record shown is for 22 x 24-in. big-end-up ingots being rolled on a 13-pass schedule. Note bad entry on third ingot.

7. Any change in roll position with steel between the rolls.
8. Unrecorded delays.
9. A visible record of bad practices and habits as consistent double-entries, bad entries into a grooved pass, and other time-consuming practices which may be used to show the roller what his particular rolling practice habits mean in seconds per ingot, tons per hour, and incentive take-home pay.
10. A continuous control record of mill operation which will enable the foremen and superintendents to know at any time what size ingot is being rolled, and in what way, when delays occur, and when there is excessive rolling time at dangerous load levels.

As a result of continuous study of mill operations under the first five items above using the draft recorder to obtain a standardization of rolling practices, drafting schedules conducive to high tonnage output at high quality may be established. Such drafting schedules can only be carried out with simultaneous studies on subsequent mills, as the 34-in. and billet mills, receiving the hot product from the 44-in. mill.

The last five items above pertain directly to supervision and to supervisor-operator relations in correcting bad habits and minimizing maintenance and delays.

In a previous study, the maximum admissible drafts for different ingot sizes from the point of view of permissible mill loads have been established. A standardized drafting schedule should be limited by considerations of both motor loads and surface quality. Therefore, maximum admissible drafts from the point of view of surface cracking are an important factor for the development of optimum drafting schedules.

Since the maximum draft on slab ingots will be largely governed by mill motor load limitations, experi-

Figure 10 — Typical draft records are for 28 x 45-in. and 27 x 53-in. slab ingots.

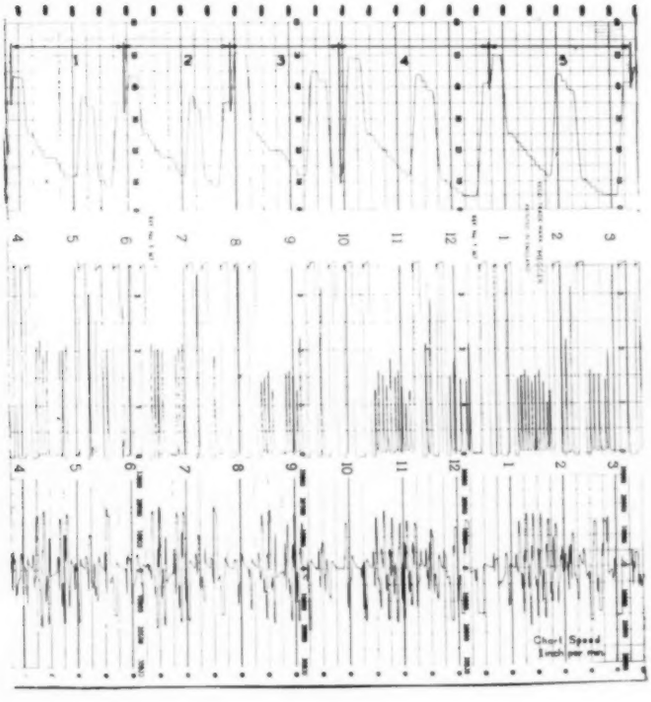


Figure 11 — Slow speed recorder is used primarily for supervisory control.

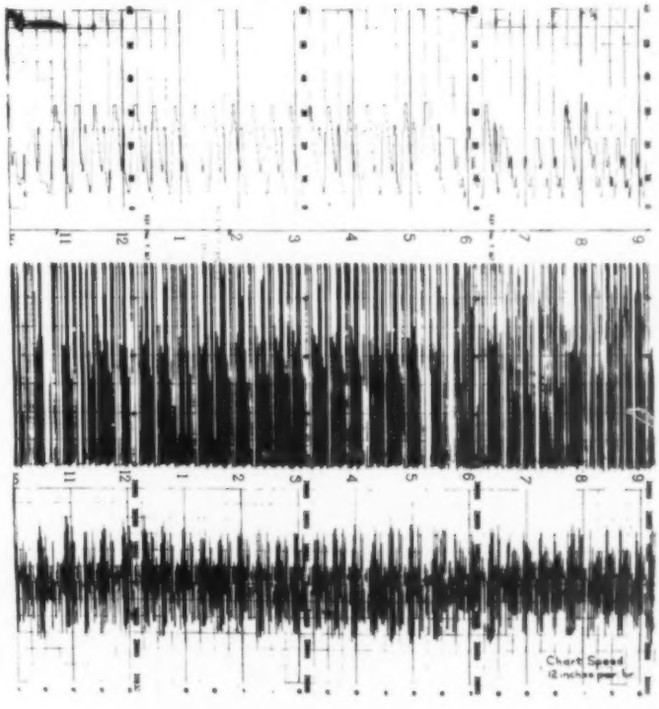


TABLE I. Rolling Practice

Mill	Entering size of ingot bloom, in.	Finish size of bloom, billet, in.	Steel grade	Rolling practice
44-In.	Mold size 22 x 24 big end up. Reusable lined Ingot size assumed 21.5 x 23.5	9½ x 10½	Alloy and resulphurized	13 pass rolling specified BXBBXBBBBXDDXDBXAA
			Others	11-pass rolling BXBBXBBXDDXDBXAA
	Mold size 23 29/32 x 25 29/32, open top	9½ x 10½		13-pass rolling BXBBXBBBBXDDXDBXAA
	Mold size 24 9/16 x 26 9/16, bottle top	9½ x 10½		13-pass BXBBBBXDDDDXDBXAA
	Ingot size assumed 24 x 26			15-pass BXBBXBBBBXDDDDXDBXAA
34-In.	9½ x 10½	5⅝ or 6-in. sq		7-pass rolling BXABXCBXDB
Billet	5⅝ or 6-in. sq	2-4		

A, B, C, D and X under rolling practice, in 44-in. mill, represent respectively the 10-in. groove, bull head, 5½-in. groove, 14-in. groove, and a 90 degree turn of ingot or bloom with manipulator.
A, B, C, D and X under rolling practice in 34-in. mill, represent respectively the 7½-in. groove, bull head, 6-in. groove, 5-in. groove, and a 90 degree turn of the bloom.

ments with heavy drafts and their influence on the surface should be conducted on bloom ingots. A survey of actual drafting practices and their consistency can be also conducted simultaneously. Bearing in mind the reasons mentioned above, bloom ingots alone have been considered in the present study.

Brief description of the blooming mill and present rolling practice—The mill is a 44-in. 2-high reversing blooming mill in tandem with a 34-in., 2-high reversing mill, and an 18–21 in. billet mill. Bloomer is driven by a 7000-hp motor.

The 40½-in. diam rolls have a 53¾-in. bull head and three grooved passes, 5½, 10 and 14 in. wide at mid-depth, with a diameter of 35 in.

The mill is served by 26 pits of various types with a total effective hearth area of 3012 sq ft.

Rolling ingots for blooms and billets comprises about 45.2 percent of the ingot tonnage and 50.4 percent of the available rolling time, whereas rolling slab ingots for plate and strip comprises about 43.5 percent of the time and 54.8 percent of the ingot tonnage. Recorded delays account for about 6 percent of the available time. The present rolling rates on slab and blooming ingots are approximately 298 and 213 ingot tons per hr with an average of about 250 ingot tons per hr. The overall produced tonnage is 210 tons per hr with a yield of 87.2 per cent.

The present rolling practice for bloom ingots is tabulated in Table I. Briefly, the molds used for bloom or billet products are 22 x 24 in. big end up reusable lined hot top, 23 x 25-in. open top, and 24 x 26-in. bottle top molds and the ingots are generally rolled to 9½ x 10½ in. in 13 or 11 passes in the 44-in. mill, then to 5⅝ or 6-in. squares in seven passes in the 34-in. mill, and then to 2-to 4-in. billets in six to four stands (and two vertical stands) in the billet mill.

Experimental work—The rolling of ingots from ten heats, consisting of three resulphurized, four high carbon, and three low carbon heats, was recorded. The heats were selected with soaking temperatures within the scheduled range and with soaking times considerably greater than that considered necessary to ensure satisfactory soaking and rolling, i.e., over one hour.

Seven heats were rolled in 13 passes; one heat in 11 passes and one heat in 15 passes. Another heat, No. 10908 (resulphurized) was rolled alternately in 13 passes and 11 passes for comparison of rolling practice and quality. The heat and rolling data are listed in Table II. Typical 13-pass and 11-pass drafting practices for 22 x 24-in. big end up, hot top ingots are shown in Table III.

Assessment of the quality in a quantitative way was difficult. It was not possible to keep the billets from each ingot separated for subsequent quality inspection by ingot. Observations taken in the billet mill after the second vertical stand, where the steel is quite scale-free, were unsatisfactory because the defects were obscured or elongated. Conditioning costs were also considered, but this could only be used on a heat basis. In addition, some grades are completely skinned and the conditioning time involved is little affected by the as-rolled surface quality. Other grades are conditioned by chipping. It was thus necessary to inspect the 10-in. blooms leaving the rolls and to derive a semi-quantitative assessment of the bloom quality by counting the number of V-ruptures in the top scale-free surface of the blooms leaving the rolls. Counts of 0, 1, 2, 3, 4 and 5 or over were obtained. With the exception of two heats, 13720 and 14264, the side observed was normal to the top side of the ingot entering the mill rolls. Although the method of inspection is subject to the criticism that only one side of the bloom is inspected, nevertheless it is felt that whether the ruptures occur by contact with the rolls or by lateral bulging, the ruptures do reflect the rolling conditions, and may, therefore, justifiably be used as an index of quality.

Uniformity of drafting practice—The percentage distribution by ingots according to the size of the draft, in in. on each pass, has been used to determine the uniformity of the rolling practice.

Blooms are rolled from ingots of almost identical measurements to an almost constant size in the 44-in. mill. Since no modification of the practice when rolling sensitive grades is specified (although the rollers themselves may perhaps be more careful), it was felt that 13- and 11-pass heats could be consolidated into one population for the percentage distribution of the drafts taken on each pass, the 11-pass rolling practice being

TABLE II. Heat and Rolling Data for Heats Observed

Grade	Heat	C	Mn	S	Mold size, in.	Assumed ingot size, in.	No. of ingots	No. of passes	Final size 44 in.	Soaking Temperature, F	Approximate soaking time, min
34/40 C-1138	12738	0.365	0.94	0.095	22 x 24	21.5 x 23.5	30	13	10.2	2300 to 2325	165
34/40 C-1138	9166	0.350	0.83	0.090		21.5 x 23.5	24	13	10.0	2300 to 2325	75
32/39 C-1137	10908	0.326	1.42	0.102		21.5 x 23.5	26	13–11	10.0	2300 to 2325	75
71/75 Rope Wire	9147	0.745	0.65	0.029	22 x 24	21.5 x 23.5	17	13	10.5	2250 to 2275	120
60/65 Ord. Sprg.	8505	0.627	0.90	0.033		21.5 x 23.5	28	13	10.5	2250 to 2275	80
65/70 HiMn Sprg.	9177	0.673	0.96	0.023		21.5 x 23.5	27	13	9.5	2250 to 2275	150
61/65 Zigzag	9155	0.644	0.95	0.029		21.5 x 23.5	14	11	10.5	2250 to 2275	
05/07 Chain	13720	0.069	0.350	0.026	24 x 26, bottle top	24 x 26	23	13	10.5	2325 to 2350	120
05/07 Chain	14264	0.068	0.330	0.026		24 x 26	23	13	10.5	2325 to 2350	120
05/07 Chain	12725	0.080	0.350	0.027		24 x 26	25	15	10.5	2325 to 2350	125

TABLE III

Typical 13- and 11-pass Drafting Practice on 22 x 24 Big-End-Up Ingots

Pass		Roll position opening, in.		Ingot-bloom size at end of each pass, in.	Draft, in.		Remarks
				21.5 x 23.5			Assumed ingot entry size
1 turn	B	20.5		20.5 x 23.8	1.0		Lateral spread assumed to be 0.3 times draft.
2	B	20.5		20.5 x 21.5	3.3		
3 turn	B	19.0		19.0 x 22.0	1.5		Lateral spread assumed to be 0.3 times draft.
4	B	19.5	[17.5]	19.5 x 19.8 [17.5 x 20.3]	2.5	[4.5]	
5	B	18.0	[14.0]	18.0 x 20.2 [14.0 x 21.4]	2.0	[3.5]	
6	B	16.5	[No pass]	16.5 x 20.7	1.5		
7 turn	B	14.0	[No pass]	14.0 x 21.4	2.5		Lateral spread assumed to be 0.3 times draft.
8	D	11.5	(17.0)	17.0 x 15.3	4.4		
9 turn	D	9.0	(14.5)	14.5 x 16.1	2.5		Lateral spread assumed to be 0.3 times draft.
10	D	7.0	(12.5)	12.5 x 15.6	3.6		
11 turn	B	10.0		10.0 x 16.4	2.5		Lateral spread assumed to be 0.3 times draft.
12	A	7.0	(12.5)	12.5 x 10.5	3.9		Restricted lateral spread assumed in confined pass with rolls close together.
13	A	4.5	(10.0)	10.0 x 10.5	2.5		

[ ] Roll opening, bloom size, and draft when 11-pass rolling employed.
( ) Actual opening in grooved passes. (Difference in diameters = 5.5 in.)

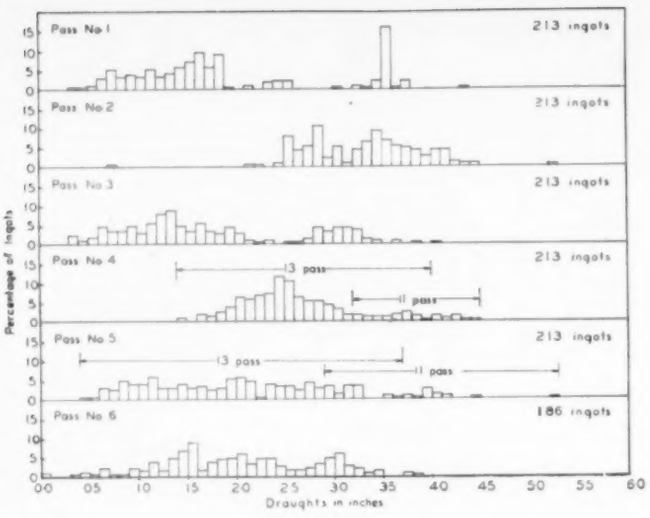
substantially the same as 13-pass rolling with the sixth and seventh passes omitted. Consequently the distributions of the drafts taken on each pass for the 213 ingots from the nine heats (few were complete heats) were obtained as shown in Figures 12 (a), (b) and (c). It will be noted that the distributions of the 11-pass drafts are substantially the same as those for 13-pass drafts except in the fourth and fifth passes where the distributions are skewed to higher drafts. The similarity of the distributions by pass for the various heats is shown in Figure 13 where the distributions for the 7-pass drafts for several individual heats have been drawn. Figures 12 and 13 show that ranges of drafts up to 4 in. have been encountered.

Bloom quality—Conventional statistical treatment of the average number of V-ruptures and the heaviest flat and heaviest edge pass, that is the heaviest draft on the surface observed and/or normal to it (accounting for the possibility of ruptures occurring by contact with the rolls or by lateral bulging for an ingot or heat) indicated the absence of even a tendency of a relationship. A similar condition was found when the V-ruptures were correlated with the heaviest draft used on each ingot.

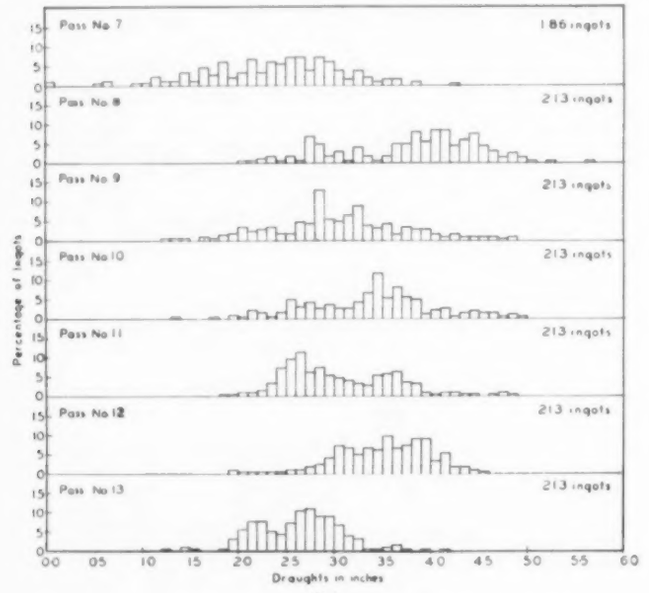
Distributions of heaviest drafts for each pass superimposed over the distribution of the corresponding average number of V-ruptures were also constructed. A total absence of any relationship for plain carbon grades was again established. Altogether, only few tears were found in the low carbon grades, and fewer in high carbon heats in spite of drafts of up to 4 and 5 in.

Only the resulphurized heats seemed to be sensitive enough to some rupture of any extent under the rolling conditions encountered in the study. For this reason, only the quality of resulphurized grades is discussed below.

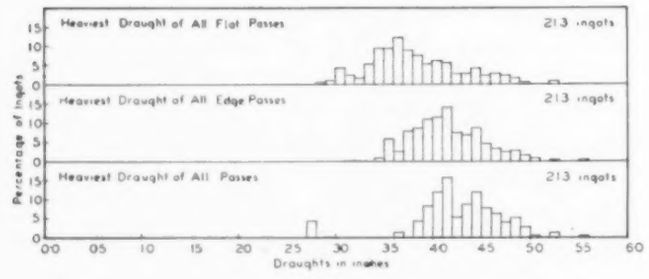
The distributions of the heaviest draft and one of the heaviest bull-head pass drafts (Pass No. 7) of each ingot in the three resulphurized heats have been plotted in Figure 14, with the distributions of the average number



(a)



(b)



(c)

Figure 12 — Distribution of drafts in each pass for 213 ingots in nine heats.

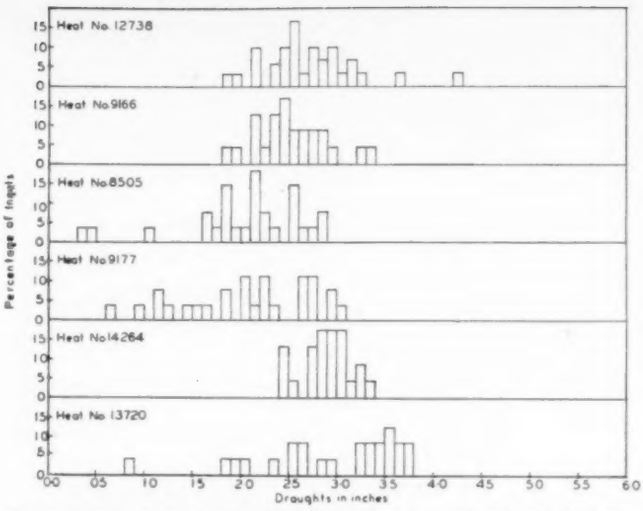


Figure 13 — Drafts for Pass No. 7 for six heats in the 13-pass rolling schedule.

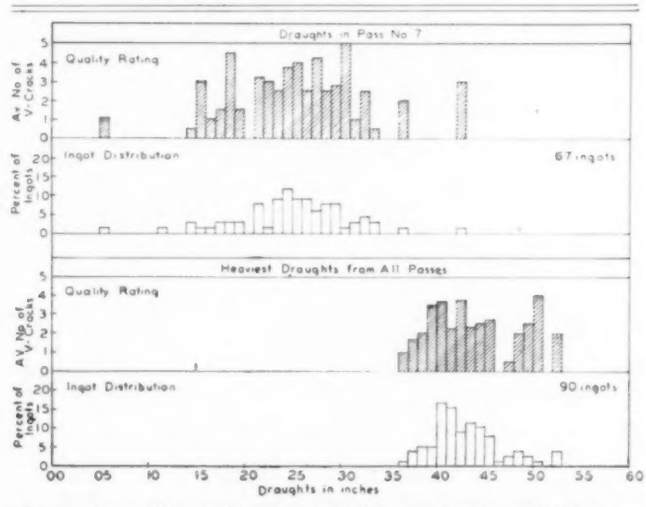


Figure 14 — Chart shows correlation between distribution of ingots by drafts and corresponding average number of V-ruptures.

of V-ruptures for each value of draft superimposed. The lower histogram gives the relative weights of the V-crack averages, that is, the relative number of ingots involved in each average. The distributions have also been carried out for each pass and for the heaviest flat and heaviest edge passes, that is, the heaviest draft on the surface observed and normal to the surface observed, for each heat separately, but the distributions were similar and therefore, have not been included in this report. Pass No. 7 (Figure 14) show such a typical distribution. Here again there is no apparent relationship between cracking and magnitude of drafts. In order to deliberately increase the drafts, half of one resulphurized heat (No. 10908) was rolled in 11 passes and the other half in 13 passes. The results of this rolling are shown in Table IV. Whereas the average number of observed ruptures per bloom was 1.15 for 13-pass and 1.85 for 11-pass practice, this last figure was well within the range and even below figures obtained on other 13 pass resulphurized heats, indicating a possible lack of relationship also in this case. A high carbon heat rolled in 11 passes did not show any ruptures whatsoever.

The average number of V-ruptures for each heat investigated is also shown in Table IV.

The conditioning, in hours per ton, for the various heats is shown in Table V. The variation from heat to heat and within the heat, in the 11-pass and 13-pass rolling of 10908, is small. Although a small part of the 13-pass tonnage shows a higher conditioning time, visual inspection indicated that the blooms rolled in 13 passes were generally of slightly better surface than those rolled in 11 passes.

A brief statistical study on resulphurized heats 12738, 9166 and 10908, treated individually and as a group was also undertaken. Particular emphasis was

TABLE IV

Comparison of Quality of 13-pass vs 11-pass and 15-pass vs 13-pass Rolling Practice

Grade	13-Pass				11-Pass			
	Heat no.	No. of ingots	Total no. defects	Average no. defects	Heat no.	No. of ingots	Total no. defects	Average no. defects
Resulphurized	12738	30	107	3.56				
	9166	24	64	2.46				
	10908	13	15	1.15	10908	13	24	1.85
		67	186	2.78		13	24	1.85
High carbon	9147	17	5	0.29	9155	14	0	0.00
	8505	28	0	0.00				
	9177	27	0	0.00				
		72	5	0.07		14	0	0.00
	15-Pass				13-Pass			
Low carbon	12725	25	19	0.76	14264	23	0	0.00
					13720	25	0	0.00
		25	19	0.76		48	0	0.00

TABLE V

Comparison of Conditioning Times for Various Heats

Heat no.	Grade	Bloom-billet size, in.	Total lb	Type	Hr per ton	Remarks
12738	34/40 C-1138	$5\frac{1}{2}$	320,705	C (Scarf)	0.38	
9166	34/40 C-1138	$5\frac{1}{2}$	186,180	C (Scarf)	0.30	
10908	32/39 C-1137	$8\frac{1}{4}$	24,660	C (Scarf)	0.36	11-pass
		$8\frac{1}{4}$	63,020	C (Scarf)	0.36	13-pass
		$8\frac{1}{4}$	63,390	C (Scarf)	0.34	11-pass
		$8\frac{1}{4}$	17,810	C (Scarf)	0.51	13-pass
9147	71/75 Rope wire	$2\frac{1}{16}$	129,480	C (Chip)	1.61	
8505	60/65 Ord. spring	$2\frac{1}{16}$	Sent direct			
9177	65/70 HiMn spring	2	154,000	C (Chip)	1.62	
9155	61/65 Zigzag spring	2	Sent direct			
13720	05/07 Chain	$2\frac{1}{2}$	Sent direct			
14264	15/07 Chain	$2\frac{1}{2}$	Sent direct			
12725	05/07 Chain	$2\frac{1}{2}$	Sent direct			

placed on the bullhead breakdown passes 4 to 7 inclusive where, it is felt, the rupturing occurs. The drafts on passes 4 to 7 inclusive total about 8 in. but the total draft is comprised of four individual drafts of varying size. The sum of squares of the four drafts has been used to establish a better criterion of total draft severity, e.g., $2^2 + 2^2 + 2^2 + 2^2 = 16$ (total draft equal to 8 in.) being a low value associated with uniform drafting and $0^2 + 0^2 + 4^2 + 4^2 = 32$ (total draft equal to 8 in.) being associated with a more severe drafting. The sums of the squared drafts were then related to the quality ratings as measured by the number of V-ruptures 0, 1, 2, 3, 4 and 5 or more.

The heat averages of sums of the squared drafts for 13-pass rolling were very similar from heat to heat, and undoubtedly represent the same population as far as drafts are concerned. The "t" test for heat averages of quality rating shows that the various heats do not represent the same population and indicates that sensitivity of the various heats to V-ruptures are significantly different. This sensitivity is the result of causes other than the rolling practice.

The correlation coefficients of the relationships between the sum of squared drafts (passes 4 to 7) and quality rating are non-significant for the 13-pass and/or 11-pass rolling of the above three heats treated individually and as a group.

Rolling times and mill load, 13-pass vs 11-pass rolling—The rolling of heat 10908 alternately in 13 passes and 11 passes afforded an opportunity to see the change in rolling time per ingot under each practice. The load chart was measured with a scale measured in tenths of inches and estimated to the nearest hundredth. Since the chart speed was one in. per min, the in. measured represented time in min. Two values were taken. The actual rolling time was measured from start of mill load to finish mill load, and the total time ingot to ingot was measured from finish mill load to finish mill load. The average actual rolling time for 13-pass ingots was 1.20 min (72 sec), and for 11-pass ingots 1.09 min (65 sec). The average total rolling times are 1.32 min (79 sec) and 1.27 min (76.2 sec) respectively.

The maximum mill load increased from an average of 12.2 kiloamperes for 13-pass rolling to 14.1 kiloamperes for 11-pass rolling. Both loads, of course, are much below the breaker settings.

Discussion of results—It has been shown that the drafting practice presently used does not result in uniform drafts from pass to pass or from ingot to ingot for the same pass. Wide ranges up to 3 in. for drafts on single passes in a single heat, and up to 4 in. for drafts on single passes in nine heats, have been observed. The degree of precision in positioning the rolls and the drift undoubtedly affect this spread but the skill and experience of the operator is also important. Better mill control could narrow the range. (No attempt has been made to compare draft distributions

by operator.) Some drafts are extremely light and must be followed by heavier than average drafts to accomplish the same bloom reduction.

The drafts taken in 11-pass rolling in the fourth and fifth passes, the sum of which is equal to the sum of the drafts taken in 13-pass rolling on the fourth, fifth, sixth, and seventh passes, overlap to some extent the drafts taken on the fourth and fifth passes of 13-pass rolling. This suggests that closer control could bring the drafts from both practices into a common population with the end result that all ingots (22 x 24 in.), not subject to the hot shortness or otherwise sensitive, could be rolled according to an 11-pass practice.

Within the range of drafts encountered, the drafts presently being obtained on low and high carbon steels up to 4 and 5 in. appear to have no effect on the surface quality of the bloom as measured by the number of ruptures. Inspection of alternately rolled 13-pass and 11-pass blooms from 10908 suggested that 11-pass rolling was somewhat inferior for resulphurized grades. However, no trend to a higher number of V-ruptures with heavier drafts is manifest in Figure 6 for three resulphurized heats.

The brief statistical treatment has shown that although the drafting practices as defined by the slabbing passes 4 to 7 were not significantly different, the sensitivities to cracking (V-ruptures) of the three resulphurized heats were significantly different. Factors other than drafting practice must influence the rupture sensitivity.

A comparison of the 13-pass and 11-pass actual ingot rolling times indicates that substantial time savings up to 10 per cent, and tonnage increases could be effected by using 11-pass rolling where quality is not affected. Such potential time savings could only be realized by an overall study to balance the rolling in the 44-in. mill with that in the 34-in. and billet mills. Changes in the finish and entry sizes throughout the mills might be required.

Summary—

1. The draft recorder installed recently on the 44-in. mill has revealed certain areas where improvements may possibly be accomplished in the rolling of bloom ingots.

2. It seems that in the case of plain carbon grades, ruptures of the surface are not created by drafts of up to 4 and 5 in. There should be a limit for maximum drafts and rolling speeds (rates of deformation) from the point of view of surface quality, but this limit seems to be outside of a reasonable possibility of the mill practices. The sensitivity to cracking should be affected by the initial thickness of the material before the pass is taken. It may become noticeable in the case where the draft is of a magnitude comparable to the thickness of the ingot, bloom or slab rolled. This does not apply to the rolling of ingots.

3. Though resulphurized grades indicated only a very light trend to rupturing with increased drafting, a more extensive study will be required to definitely and quantitatively substantiate this trend.

4. It should be realized that, in view of the limited time available for preparation of this paper and the consequent limited data, definite conclusions concerning the influence of draft on bloom quality should be made with some caution. When more work is done, a more accurate and positive comparison can be made.

5. If the range of drafts encountered can be decreased by greater care in roll settings and by a more precise preselector control on the screw-down mechanism, higher average drafts may be obtained on nonsensitive steels with no deterioration in quality. Such a practice could result in a decreased number of passes and shorter rolling times.

6. A more thorough study of the sensitive grades is required before any reduction in the number of passes may be considered.

7. It seems to be possible to reduce the number of passes on bloom ingots of plain carbon grades without affecting the surface quality. Such a decrease of the rolling time will be conducive to a noticeable increase in tons per hour on the 44-in. mill.

8. A standardization of the drafting practices will result in an increase in tons per hour and probable decrease in cost of maintenance of the equipment.

9. Any drafting schedule in the 44-in. mill which materially decreases the rolling time must be accompanied by a balancing of the rolling through the 34-in. and billet mills, and by the ability of the pit operation to keep steel on the delivery table.

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AISE
WEST COAST MEETING
March 4, 5, 6, 1957
St. Francis Hotel San Francisco, Calif.

REDUCING DELAYS IN BLAST FURNACE CAMPAIGNS

by improving mechanical features

By
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. . . . improvements in lining life of blast furnaces have extended campaigns to the point where mechanical details suitable for the older furnaces have now become the weak spots in the newer ones . . . . suggestions for improving a number of mechanical details to avoid failures during the campaign are given in this paper . . . .

▲ THE major reason for concluding the blast furnace campaign has historically been lining failure. This failure could involve one or more of these areas: (a) the hearth, (b) the inwall or stack, (c) the stockline. Hearth breakouts, hot spots and loss of stockline wearing plates were specific items which necessitated an extended shutdown. Furnaces were relined sectionally or completely, depending on the tonnage, life and general condition of the unit. Many companies consider 2500 days, or 6 years 10 months as a respectable campaign.

Looking back over the years, the quality of the refractories which went into the linings, while good, left something to be desired. Generally speaking it was the governing factor in determining campaign life. More recently the advancements in the technology of brick manufacture have resulted in a considerable improvement in the ability of the furnace to perform its mission for a longer period. Then too, somewhat over one-third of the furnaces now have carbon to an increasingly greater extent as a part of the lining. This too has lengthened the useful life of the furnace with the end not in sight.

The tonnage produced on a lining, as it affects life, can be a misleading figure. Furnace sizes have shown a steady increase over the years with resultant production increases. Furthermore, while raw materials degenerated in Fe content during the forties, the effects of increased beneficiation including sinter, concentration and pelletizing, plus higher Fe foreign ores, reversed this trend in the fifties and still further production gains are anticipated in the near future. High top pressure operation on twenty-eight American furnaces likewise has effected the output versus lining life picture.

This lengthening life of the lining, together with the greater quantities of raw materials processed, has increasingly brought attention to the ability, or perhaps better still, the inability, of the structural and mechanical components of the furnace plant to stand up under this work load.

Several examples can be cited to illustrate this.

On December 14, 1954, it was noted that No. 6 blast furnace was sending up a smoke signal each time the small bell was dumped. Investigation showed a hole 8 x 24 in. in the south quadrant of the large bell. The edge of this hole was worn paper thin. The north and west quadrants were wrinkled and the bell did not seat snugly on the north.

Four days later the furnace was banked for 84 hr, 37 min to replace the large bell. At the same time, the following other items were renewed: large bell rod, small bell, seat, rod and wearing rings, wearing plates in the receiving and small bell hoppers.

The large bell hopper was replaced to insure an accurate seat for the new large bell.

This 25-9 in. hearth diam furnace had 2,707,040 net tons on the lining and had been in blast since July 19, 1948, with the exception of several strike bank periods, a total of 2210 days. There were no indications of lining failure and the stockline was in excellent condition. This furnace was relined on May 4, 1956, after 3,363,366 net tons and 2708 days (7 years 5 months). The lining had never been patched and still had 20 in. of brick at the thinnest point in the stack.

Until several years ago, 2,500,000 net tons was considered satisfactory for this size furnace and on that

Figure 1 — View of both halves of small bell seat shows loss of section at bottom in two areas. Seat is inverted in photograph.

basis the bell would have lasted the campaign. Now 3,200,000 net tons or better is expected and redesigning is under consideration.

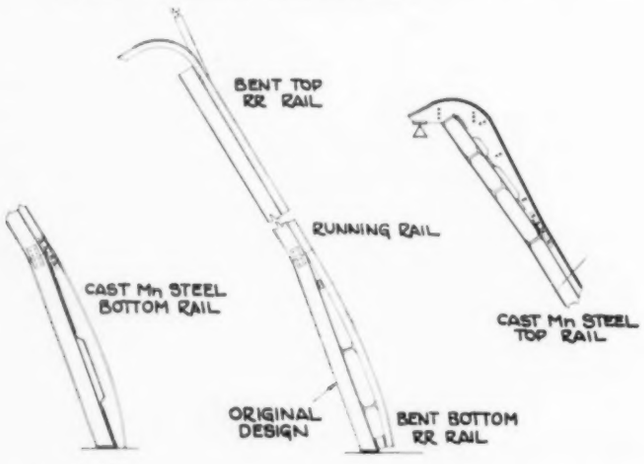
No. 4 blast furnace had a small bell seat (lower section of the rotating hopper) failure on January 18, 1956 (Figure 1). The thinness of the edge showed the loss of sections to be the result of wear. Replacement required a bank of 23 hr-15 min. A new small bell was installed as well as a set of new distributor packing gland segments and various hopper wearing plates.

The hearth diameter of this furnace is 20 ft-0 in. It had been relined April 29, 1950, been operating 2086 days and had made 1,760,708 net tons. The next relining is scheduled for May, 1957, at which time an estimated 2,200,000 net tons will have been produced.

Again, mechanical design, which at one time was probably adequate, caused an unexpected delay in production.

In the following paragraphs an effort has been made to review those locations and items of equipment which are proving fallible as a result of the longer campaign and which necessitate production delays to repair or renew. They are based on our experience at Inland Steel Co. In some cases corrective action has not yet been taken as this is the first attempt to review the situation as a whole. However, some individual improvements have been made in the past and they are noted herein. Moreover, not all the changes have been for the best, which is perhaps another way of saying that the final and correct modification is still in the future.

Figure 2 — Original skip rails were redesigned bottom and top for manganese steel castings.



Skip bridge rails—The bottom, running and top rails on the skip bridge as originally installed were conventional railroad type, 109.55 lb per yd. Bottom and top rails were bent to fit. See Figure 2.

After some nine years of experience on the larger furnaces, it was decided that improvements could be made on the bottom rails as they were being replaced about every four years. The wear in this area was attributed to the side-charging of coke into the skips, together with the operation of water sprays in the coke hoppers. The fine abrasive particles of wetted coke lodged under the wheels of the skip buckets and in effect acted as a grinding compound.

On the 1948 relining of No. 6 furnace, the bottom rails were replaced by manganese steel castings. The results were good enough to warrant converting each of the four larger furnaces to these castings as they were relined. This change has extended the rail life to about six years. Where the water sprays have been relocated, no replacement is needed in a campaign. Of interest is the fact that the four smaller, older furnaces do not have side delivery of coke and bottom rail wear has not been a problem.

The top dumping rails likewise have not been trouble free. One shutdown per furnace campaign was scheduled for their renewal. In the fall of 1955 on "A" furnace relining, and in June, 1956, on No. 6 furnace relining, manganese cast-steel rails were installed. While it is too early to comment on the expected improvement,

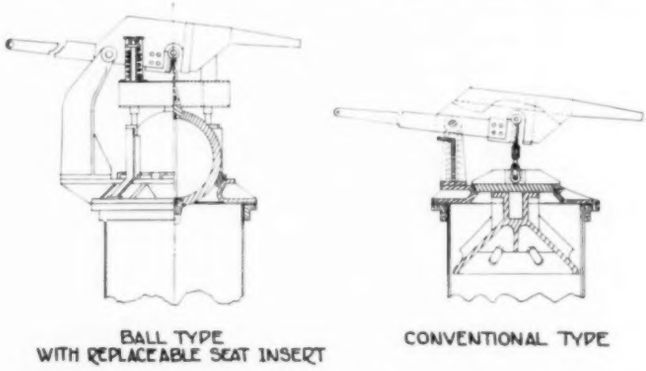


Figure 3 — Blast furnace bleeder valves have replaceable seat inserts.

there is no reason to doubt that much less wear will be noted.

Skip sheave wheels—The large sheave wheels on top of the furnace structure and which carry the skip cables are commonly known as bull wheels. These generally are not a source of operating delay and should last the campaign. However, it was learned that a neighboring steel plant had had some shaft breakage. Bull wheels are unwieldy to change and require a furnace shutdown so in 1948 the section of the shaft which carries the sheaves was increased from 7½ to 10 in. diam. No change was made in the bearing size although some companies have found this desirable. The en-

larged shafts and modified wheels are being installed as furnaces are relined. To date no failures have been experienced.

Bleeder valves—The wear and tear on normal pressure furnace bleeders has always been a problem. High top pressure has greatly accelerated their failure.

At this time comments can only be made on the former situation although one furnace is now being converted to high top pressure.

The standard bleeder has consisted of a valve, bell, and seat as shown on Figure 3. Several years ago two modified bleeders were installed as replacements. One was hard-surface welded and ground on the seat, retaining the original contact area. The other had the

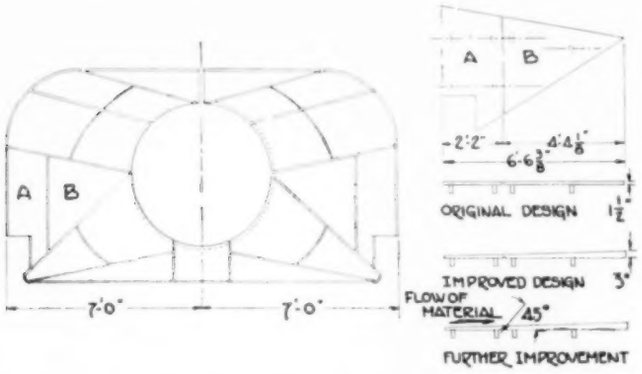


Figure 4 — Receiving hopper wearing plates are 12 to 14 per cent manganese castings.

seat remachined to reduce the contact area from 1½ to ½ in. In neither case was the modification successful.

However, in the spring of 1952 when No. 5 furnace (25 ft-9 in.) was relined, an experimental ball-type bleeder was installed. This was designed with an easily removable seat insert and a ball which could be reversed 180 degrees if necessary. The seat was straight-line so as to make point contact with the ball. The theory behind this design was, of course, that a ball would reseat itself more easily after a furnace slip. Further, if the ball cut, it could easily be reversed and if the seat insert cut there would be a minimum delay in changing it.

This bleeder had behaved so well by November, 1955, that this type was installed 100 per cent on "A" furnace (25 ft-9 in.) relined at that time, and appears to be well on the way to becoming the standard at this plant. To date the original No. 5 furnace bleeder has shown no sign of leakage.

Receiving hopper wearing plates—For many years receiving hoppers on furnace tops have been lined with replaceable wearing plates of 12 to 14 per cent manganese steel castings, designed with uniform cross-sectional area. See Figure 4. Replacement of those plates which received the greatest wear was necessary every 18 months to two years. To do this job, in the interest of safety, required a furnace shutdown. While the plates were held in place by keys for speedy changing, still there was a production loss of an hour or so depending on how many plates were involved.

The first step toward improving this situation was taken prior to the 1952 relining of No. 5 furnace. The lower plates which took the greatest wear were redesigned, as shown, with a tapered cross-sectional

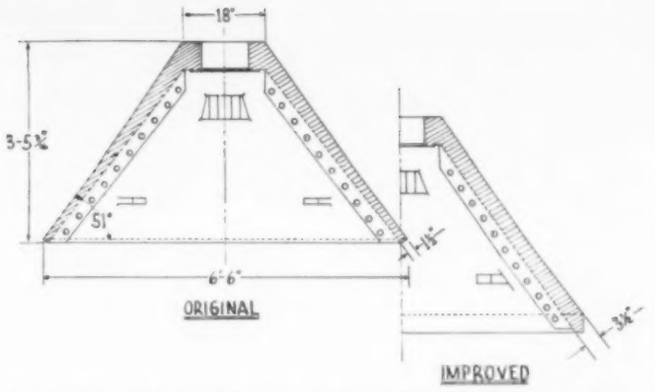


Figure 5 — Cross-section shows small bell for 25-ft-9-in. furnace.

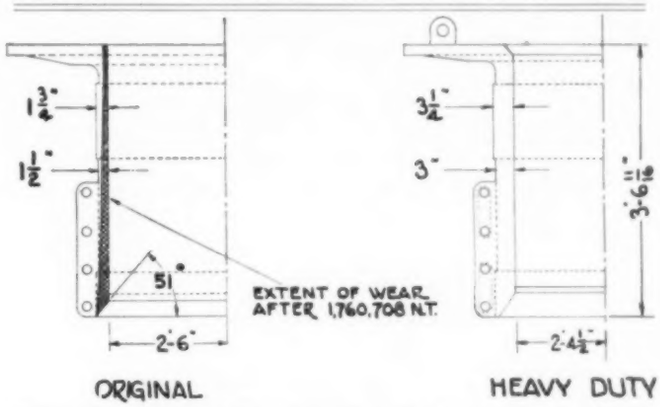


Figure 6 — Small bell seat sections had wearing thickness practically doubled.

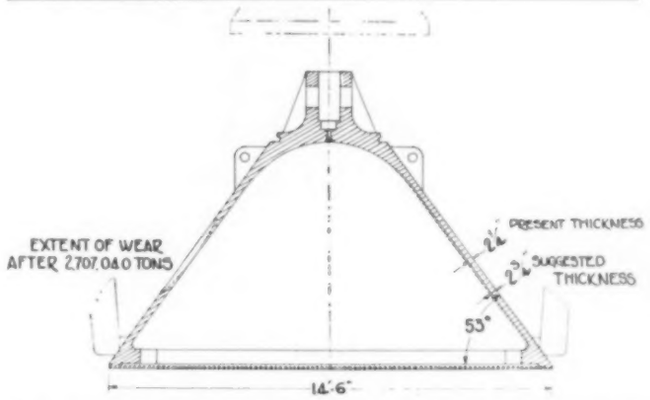
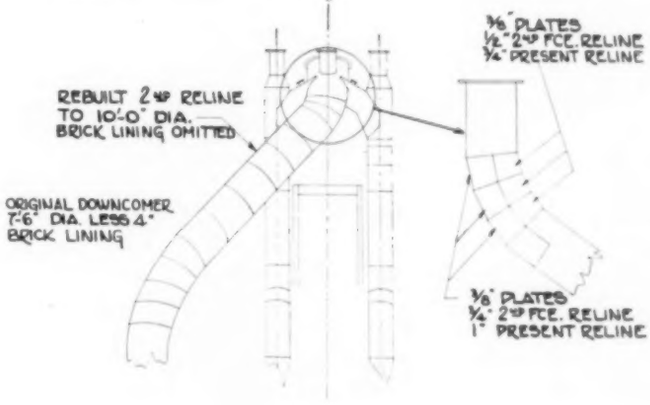


Figure 7 — Large bell of 25-ft-9-in. furnace shows location of wear and proposed improvement.

Figure 8 — Downcomer for 25-ft-9-in. furnace shows enlargement and increases in plate thickness at upper bend.


⅜" PLATES
½" 2ND PCE. RELINE
¼" PRESENT RELINE
REBUILT 2ND RELINE TO 10'-0" DIA. BRICK LINING OMITTED
ORIGINAL DOWNCOMER 7'-6" DIA. LESS 4" BRICK LINING
⅜" PLATES
¼" 2ND PCE. RELINE
1" PRESENT RELINE

area. This has been a definite improvement inasmuch as these plates were changed for the first time in the summer of 1956, a life of four years.

Note the horizontal butt joint between castings. This has been an undesirable feature which tends to catch the charge materials and wear very rapidly. The solution in this area is to overlap the plates in the direction of material flow.

Small bell—Traditionally a blast furnace superintendent expects to replace the small bell at least once during a campaign. There are few pieces of equipment which take the wear of this item. Every pound of ore, coke, stone and scrap which enters the furnace passes over its surface. Each replacement represents a delay.

About 1947 steps were taken to increase the thinnest section of this manganese steel casting from 1½ to 3½ in. (Figure 5). Since then no small bells have been changed within a campaign except as dictated by large bell failure or small bell seat failure. (Note opening paragraphs of this paper).

Cutting at the point of contact of the two halves by steam and gas has not been eliminated. Some companies are welding this joint at the time of installation and this is being given serious consideration.

Small bell seat (lower section of rotating hopper)—As mentioned in the opening paragraphs, the small bell seat on No. 4 furnace wore through after nearly six years service. This seat had a cross-section of 1½ to 1¾ in. and was cast of 12 to 14 per cent manganese steel (Figure 6). About 1948 serious consideration was given to enlarging the section to 3 to 3¼ in. and in fact such a seat was cast for use on the 1950 relining. For some reason not now known, it was not installed at that time. The wisdom of the proposed change was apparent after the January, 1956, failure and future seats will be of the heavy duty type.

Large bell—Figure 7 is a drawing of the large bell which wore through after 2,707,040 net tons of hot metal production. The hole was 8 x 24 in. and as expected was directly under the lip of the small bell. It has been suggested that an additional one-half in. of steel be added to the under side thus increasing the thickness to 2¾ in. This should allow for another half million tons or so which would be approximately the expected lining life.

Downcomer—Original construction of the single downcomer on the four 25 ft-9 in. furnaces called for an inside steel diameter of 7 ft-6 in. (Figure 8). There was a four-in. brick lining which further reduced the diameter to 6 ft-10 in. The downcomers were fabricated of ⅜ in. plate. With 75,000 cfm wind on the furnaces, this gave a velocity of 47 fps. After several years, the brick would fail in the area of the upper bend and shortly thereafter the steel plate would require patching. The welding of patch plates would be repeated several times prior to relining.

On the second campaign of No. 6 furnace the downcomer was enlarged to 10 ft-0 in. diam and the brick was omitted. This reduced the velocity to 22 fps. No wearing plates were installed incidently. The original ⅜ in. plate was increased to ½ in. with a further increase on the outside sheets of the upper bend to ¾ in. On this campaign only one patch was required at 2,932,970 net tons and 2543 days.

Further changes were made on the upper bend section on the May, 1956, relining (third campaign) to again increase this section only from ½ to ¾ in. on the inside and from ¾ to 1 in. on the outside. This is expected to eliminate any need for patching between campaigns, even though the average wind rate on the furnace has risen to 80,000 cfm.

Bosh plate pipe nipples—The pipe nipples for the top row of bosh plates which are located just below the

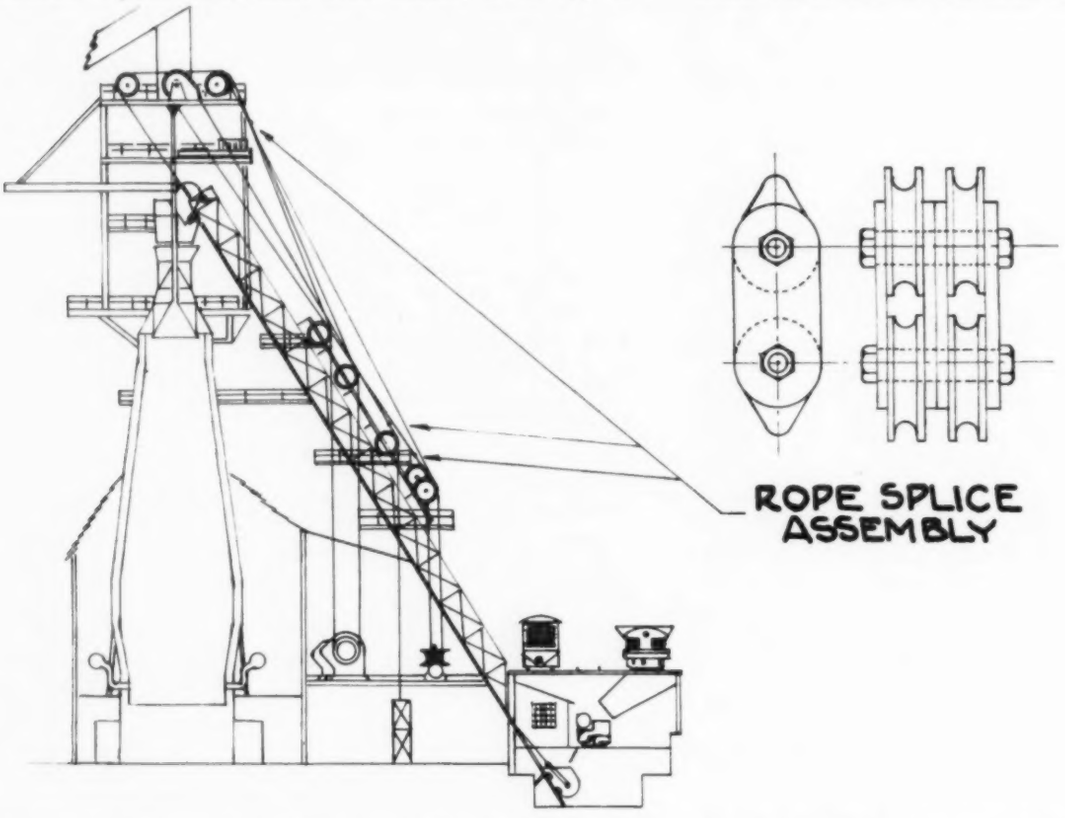


Figure 9 — Small and large bell pull cables and large bell counterweight cable show location of rope splice assemblies which facilitate cable changes.

mantle are subject to considerable corrosion from the hot burning bosh gas. It has been necessary to change a number of them due to leakage prior to relining. The area is awkward to reach and because of the heat and gas, the furnace is drafted to do the job.

On the 1955 relining of "A" furnace and the recent one on No. 6 furnace, stainless steel pipe nipples were installed for this top row of bosh plates. While stainless is obviously more expensive than galvanized pipe (which Inland uses throughout the bosh), it is expected that the problem of corrosion will be solved thus eliminating replacement during a campaign.

Small and large bell pull cables and large bell counterweight cable—These cables could be expected to last about two years but actually wore out only in the area of the sheave wheels. Cables of this length could not be changed without stopping the furnace filling longer than desirable and so the furnace had to be drafted thus losing production.

Some years ago these cables were sectionalized by means of rope splice assemblies. See Figure 9. By doing this, the short lengths of cable which pass over the sheave wheels can be replaced in 15 to 18 minutes without a furnace delay. The new cable is prepared in advance with the ends secured around a thimble. At the time of changing, the splice assembly pin is pulled, old thimble with cable removed, new thimble inserted and the pin replaced.

The straight sections of 1¼ in. cable which never pass over a sheave wheel are made of galvanized steel wire and last the campaign.

SUMMARY

As stated earlier, this paper has attempted to bring together those mechanical and engineering features which formerly were adequate for the life of the furnace campaign but which, with longer lining life expectancy, are now requiring replacement. It is believed considerable improvement has been made in this direction, although items such as bleeder valve wear on high top pressure furnaces and bell leakage has not yet been overcome.

Because design and operating practice varies widely from plant to plant, the areas of failure and the corrective action likewise will vary. Hence the foregoing probably does not cover everyone's problems, but certainly should point out the major ones which affect production.

DISCUSSION

PRESENTED BY

F. W. KIRSCHMAN, Superintendent, Blast Furnace Maintenance, United States Steel Corp., Homestead District Works, Munhall, Pa.

CHARLES P. FRAME, Mechanical Foreman, Inland Steel Co., East Chicago, Ind.

W. M. KREGLOW, Superintendent Blast Furnaces, Bethlehem Steel Co., Johnstown, Pa.

GEORGE FRENCH, Assistant to Superintendent, Blast Furnace Division, Bethlehem Steel Co., Bethlehem, Pa.

WILLIAM H. COLLISON, Plant Superintendent, Blast Furnaces and Coke Works, Great Lakes Steel Corp., Ecorse, Mich.

F. W. Kirschman: I was particularly interested in the bleeders, and am wondering whether or not these bleeders could be applied to high pressure top? I would like to know whether you have tried it. One of the problems with high pressure top is that you have considerable trouble with bleeders.

Charles P. Frame: We are now converting one furnace to high pressure top. The bleeders designed for this furnace are not the ball type bleeders. However, with the proper study and modification of design, I see no reason that they could not be used.

W. M. Kreglow: Without the bell protection under your ball bleeder, does not that ball subject itself to considerable wear even though you have a good seat to begin with? I wonder how long you maintain it?

Charles P. Frame: Underneath this ball type bleeder we have a series of overlapping baffles that stop any upheaval of material, such as coke, stone, etc. They are sloped to such a degree that if any material does fall on the baffles, it will slide off back into the furnace. After four years on No. 5 furnace, there has been no evidence of either ball or seat wear.

George French: I was particularly interested in the bell ropes. You quoted a change time of fifteen to eighteen minutes, with the blast on the furnace. We use sectionalized ropes at Bethlehem, but I think it would take us fifteen minutes to get the bell levers locked up. Do you have some special sequence of operation that you use at your plant during this change? Changing of bell ropes is a source of serious delay at our plant.

Charles P. Frame: It takes us about fifteen to eighteen minutes to change a section of these wire ropes that pass over the sheave wheels. While the furnace is being filled, we station men at the necessary positions to do the job. The minute the furnace is full, the man in the motor room locks out all the switches and then immediately notifies the men on top. In this manner we save quite a lot of time. Incidently, our small and large bells are the pull-open type with electric bell rigs. They are counterweighted to stay closed when empty.

William H. Collison: In what range of pressures is the ball bleeder practical? Can it be relied upon to seat with connecting rod at different angles?

We have heard of serious build-ups in some large downcomers, apparently because slower velocities have resulted in temperatures below the dew-point at the down-comer wall in some areas. Have you had any indication of such difficulty with your design?

Charles P. Frame: In 1952 we installed this particular type bleeder on No. 5 furnace, which was experimental. So far it has proven out very well. The theory behind it, of course, is that the ball seats are the insert regardless of what position it may take, while the conventional type bleeder, as you all know, becomes tilted and caught on one side or the other. If this is not promptly corrected, then you get a cutting action at various places.

Our furnace top pressure ranges to 55 in. of water. We have had no experience at higher pressures.

Our plant has experienced no buildup in the downcomer when reducing the velocity from 47 fps to 22 fps as a result of enlarging the downcomer.

TENTATIVE PROGRAM

AISE Western Meeting

ST. FRANCIS HOTEL SAN FRANCISCO, CALIFORNIA

March 4, 5, 6, 1957

MONDAY, MARCH 4

8:30 am—REGISTRATION

9:00 am—TECHNICAL SESSION—Colonial Room

Chairmen: W. T. Purvance, Works Engineer, Columbia-Geneva Steel Div., United States Steel Corp., Provo, Utah

G. W. Teskey, Jr., Superintendent Open Hearth, Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.

"Basic Hot Blast Cupola as Source of Hot Metal for Steel Plants," by E. S. Harman, President, E. S. Harman Corp., Chicago, Ill., and Siegfred Tunder, Vice President and General Manager of Technical Operations, GHW Gesellschaft fur Huttenwerksanlagen, M b.H., Dusseldorf, Germany

"The All-Basic Open Hearth Furnace," by R. P. Heuer, Vice President, and M. A. Fay, Assistant General Sales Manager, General Refractories Co., Philadelphia, Pa.

"Economics of Oxygen Generating Stations for Steel Mill High and Low Purity Oxygen Applications," by Arthur E. Steele, Assistant to General Sales Manager, and Donald E. Cummings, Manager, Steel Mill Sales Division, Air Products, Inc., Allentown, Pa.

2:00 pm—TECHNICAL SESSION—Colonial Room

Chairmen: E. C. Thomas, Works Manager, Pacific States Steel Corp., Niles, Calif.

R. J. Tremblay, General Manager, Bethlehem Pacific Coast Steel Corp., Los Angeles, Calif.

"Industries' Water Problems and Their Solution," by H. Riegel, Superintendent Utilities, Kaiser Steel Corp., Fontana, Calif.

"Mill Gearing as Viewed by a Lubrication Engineer," by A. E. Cichelli, Lubrication Engineer, Construction Engineering Dept., General Offices, Bethlehem Steel Co., Bethlehem, Pa.

"Selection and Economy of Equipment for Blooming and Slabbing Mills," by Kurt Schlesinger, Project and Sales Engineer, United Engineering and Foundry Co., Pittsburgh, Pa.

"Recent Development in Slabbing Mills," by H. J. Kalberkamp, Chief Engineer, Mesta Machine Co., Pittsburgh, Pa.

TUESDAY, MARCH 5

9:00 am—TECHNICAL SESSION—Colonial Room

Chairmen: William Brill, Director of Engineering, The Colorado Fuel & Iron Corp., Pueblo, Colo.

W. F. Pruden, Chief Engineer, Columbia-Geneva Steel Div., United States Steel Corp., San Francisco, Calif.

"The Facility Round-Out Program at Columbia-Geneva," by Harold G. Degitz, Staff Engineer, Columbia-Geneva Steel Div., United States Steel Corp., San Francisco, Calif.

"Coordination between Engineering and Other Departments," by J. William DePoy, Chief Engineer, Pacific Coast Div., The Colorado Fuel and Iron Corp., Oakland, Calif.

"Silicone Lubricants and Protective Coatings in the Steel Industry" Part I—**"Silicone Lubricants,"** by W. H. Ragborg, Laboratory Supervisor, and W. H. Badger, Development Engineer, Fluids Section, Product Development Laboratories, Dow Corning Corp., Midland, Mich.

Part II—**"Silicone Protective Coatings,"** by R. C. Hedlund, Supervisor, Coatings Laboratory, Product Development Laboratories, Dow Corning Corp., Midland, Mich.

2:00 pm—TECHNICAL SESSION—Colonial Room

Chairmen: C. C. Brandt, Superintendent, Electrical Department, Bethlehem Pacific Coast Steel Corp., Los Angeles, Calif.

E. F. Donatic, General Superintendent, Kaiser Steel Corp., Fontana, Calif.

"Greater Flexibility for Wire Drawing," by R. C. Suttle, Application Engineer, Reliance Electric & Engineering Co., Cleveland, Ohio, and Maurice A. Nye, Chief Engineer, Vaughn Machinery Co., Cuyahoga Falls, Ohio

"Control of Strip Thickness on Hot Strip Finishing Mills," by R. A. Phillips, Analytical Engineering Section, and H. S. Maxwell, Steel Mill Engineering, Systems Application Engineering Section, General Electric Co., Schenectady, N. Y.

"Steel Mill Distribution System Studies," by D. Dalasta, General Engineer, and F. Nolan Application Engineer, Switchgear Department, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

"The Application of Static Switching to the Steel Industry," by D. Lawrence Pierce, Assistant Manager, Control Dept., Motor & Control Div., Westinghouse Electric Corp., Buffalo, N. Y.

7:00 pm—INFORMAL STAG DINNER—Colonial Room

WEDNESDAY, MARCH 6

Inspection Trip to South San Francisco Plant, Bethlehem Pacific Coast Steel Corp., San Francisco, Calif. Buses will leave the St. Francis Hotel at 8:30 am.

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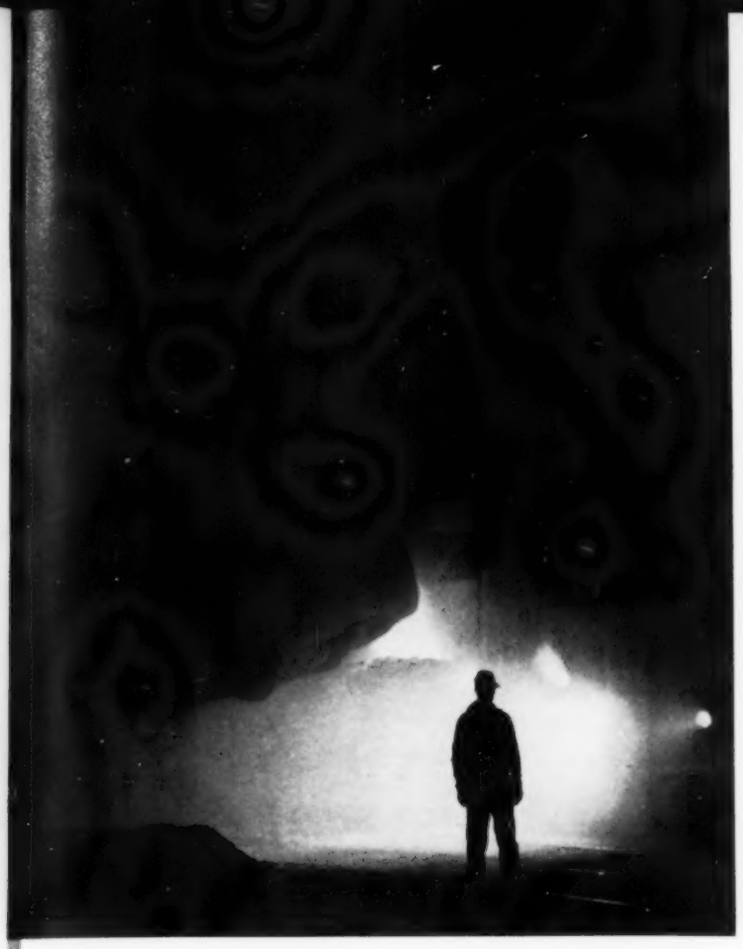
hotel reservations

Write direct for hotel reservations to St. Francis Hotel, Union Square, San Francisco 19, Calif., giving time of arrival and type of accommodation desired. Reservations should state that they are for AISE Western meeting.



DEVELOPMENTS in the IRON AND STEEL INDUSTRY during 1956

by I. E. MADSEN

GENERAL

▲ 1956 was a year in which steel management could take great pride, for it was a year of magnificent accomplishments despite many difficulties. Although strike-bound for more than five weeks, production was second only to record 1955.

Steel management continued to improve and add to their facilities. All indications are that expansion is not a limited objective but a continuing operation in an expanding economy. The bugaboo of over-expansion does not color the thinking of the modern steelman. His big problem is to obtain the capital to finance it. Much of this must come from earnings, which means higher prices.

In expansion programs, emphasis is on making more steel of better quality at lower costs, and on turning out products more highly finished—thus reducing processing by the ultimate user. Steel is broadening its activities and market, upgrading its products. Products such as stainless, titanium, plastics and coated steels ready for use are forming a larger proportion of the product mix. Demand for steel products is strong, and there seems to be a market for all that can be made.

An outstanding activity in the steel industry is the attempt made by the industry to improve public relations. Many of the installations which are being authorized have for their main purpose the elimination of nuisances such as air pollution, stream pollution and, in some cases, noise. If these developments portend anything, they mean that steel wishes to be a good neighbor.

Total production of steel in the United States in 1956 was estimated at 115,200,000 net tons or 90 per cent of the January 1, 1956, capacity. Of this, open hearth production totaled about 102,860,000 net tons or 92 per cent of capacity; bessemer production totaled 3,240,000 net tons or 68 per cent of capacity, electric furnace production totaled 9,100,000 tons or 81 per cent of capacity. Of the steel produced, 89 per cent was made in the open hearth, three per cent was made in the bessemer and eight per cent was made in the electric furnace. Compared with last year, electric furnace proportion was up less than one per cent and the open hearth furnace was down about one per cent with the bessemer remaining the same.

These figures compare with a total of 117,036,085 net tons in 1955 or 93.0 per cent of capacity. Of this, open hearth steel was 105,359,417 net tons or 95.6 per cent of capacity; bessemer production was 3,319,517 tons or 69.3 per cent of bessemer capacity, and electric furnace production was 8,357,151 tons or 77.3 per cent of

At the beginning of 1956 steelmaking capacity totaled 128,363,090 net tons. This increased during the year by 5,096,060 tons to a new capacity of 133,459,150 net tons effective January 1, 1957. Blast furnace capacity went up 1,332,720 net tons to a new figure of 86,817,950 tons on January 1. Coke oven capacity of the steel industry on January 1, 1957, was 72,970,980 net tons, a gain of 1,462,580 tons in 1956.

electric furnace capacity. Electric furnace steel in 1956 was the only category that exceeded 1955's production.

The year 1956 saw the first month when over 11,000,000 tons of steel were tapped. This was October which set a new record with 11,048,513 tons of steel.

Shipments of finished steel products in 1956 totaled about 83,900,000 net tons.

Blast furnace production in 1956 was estimated at 76,200,000 net tons of pig iron and ferro-manganese equivalent to about 89 per cent capacity. This compares with a production of 77,646,415 tons in 1955 or 92.4 per cent of capacity.

Total coke production in 1956 was about 75,000,000 net tons, approximately the same as 1955.

Looking ahead 1957 appears to some people as a year in which record steel consumption and production will be attained. Some estimates indicate that steel output will run up to 120,000,000 tons. Factors are high personal income, rising consumer spending and gains in business spending. It is also expected that car production and construction will both exceed 1956. Other crystal ball gazers see capacity operations well into 1957, followed by a lightening of demand.

Expansion in the steel industry in 1956 continued at a hectic pace. Approximately $1,257,000,000 were spent in 1956 on new facilities, somewhat above the previous record of $1,210,000,000 in 1953 and considerably higher than the $863,000,000 of 1955. Present plans indicate that the comparable figure for 1957 might exceed $1,600,000,000.

To bolster the expansion program, many of the mill machinery builders have been increasing their output and it is believed that steel expansion programs will not be held up by shortages of equipment. A number of other suppliers have also increased their capacity, adding new facilities and streamlining production methods. Lack of engineering personnel is one of the chief headaches. In some cases, manufacturers have trouble with steel for building their equipment.

A survey made by the American Iron & Steel Institute during the year showed that some 15,000,000 tons more of steelmaking capacity is planned between January 1, 1956 and 1959, considerably more than the 3,600,000 tons added in the three years ending December 1955. The cost of the new program will average about $200 per ton. Much of the increase will be provided through modernization of existing facilities; only a few new open hearth furnaces are involved, and perhaps only two or three new blast furnaces. A number of oxygen converter units and electric furnaces, however, are on the program, and a large number of sintering units will help pig iron production. This approach to expansion is largely due to the prohibitive cost of new facilities.

During the year, Benjamin F. Fairless reported that the steel industry will have to spend between $1,000,000,000 and $1,500,000,000 a year in each of the next five years merely to replace the steelmaking facilities which are worn out or obsolete. Because of existing provisions of the tax law, depreciation allowances will fall about $3,000,000,000 short of the money needed to do this job. These figures are based on replacing four per cent of existing steelmaking capacity each year. They point out the need for realistic tax allowances for the steel industry if it is merely to keep up, let alone take care of expanding steel requirements.

Also of interest is Roger M. Blough's report that, in the past 15 years, cost per employee-hour for United States Steel rose at an average annual rate of almost 9 per cent compounded, and employment costs alone rose 8 per cent a year on the same basis. On the other hand, actual productivity increased by only 2 per cent annually. In the same 15-year period, steel prices were increased by an average annual rate of less than 5½ per cent. Cost of equipment purchased for the steel mills has been rising at a rate of almost 8 per cent each year during the past ten years. For example, 25 years ago an open hearth plant was built at a cost of $10,000,000. In the ensuing 25 years, $10,000,000 has been recovered through depreciation. To replace this plant at the present time would cost $64,000,000, although depreciation allowances has allowed only $10,000,000. This presents a serious problem.

An example of the difficulty of replacing and modernizing equipment is the problem faced by Armco at their Butler plant. The original hot strip mill cost $2,000,000 in 1926 and a new hot mill to replace it now will cost $25,000,000. Similarly, a 50-hp mill type electric motor which cost $1300 in 1946 now costs $3946. Iron ore has more than doubled, steel scrap is almost three times that of 1946, and employment costs have gone up 108 per cent from $1.46 to $3.03 per hour.

Construction of new facilities was emphasized during the year. Shown here is new blast furnace plant for Pittsburgh Coke and Chemical Co.

In 1946 when steel capacity was 92,000,000 tons, investment in property was $5,700,000,000. Since then 36,000,000 tons of capacity have been added at a cost of about $12,000,000,000. Thus, a 40 per cent increase in capacity, has raised capital investment 110 per cent, yet much of the new capacity came from the relatively inexpensive process of rounding out and improving existing facilities—and the possibilities of this are dwindling. Before long, additional capacity must come from new, expensive facilities.

There were several mergers of steel companies during the year and plans made for others. The long awaited plan for merging Bethlehem Steel Co. and Youngstown Sheet & Tube Co. was announced in December. Bethlehem plans to take over Youngstown's properties and assets in return for Bethlehem common stock. The U. S. Justice Department took immediate steps to block the move. Extended litigation appears probable before a final decision is reached.

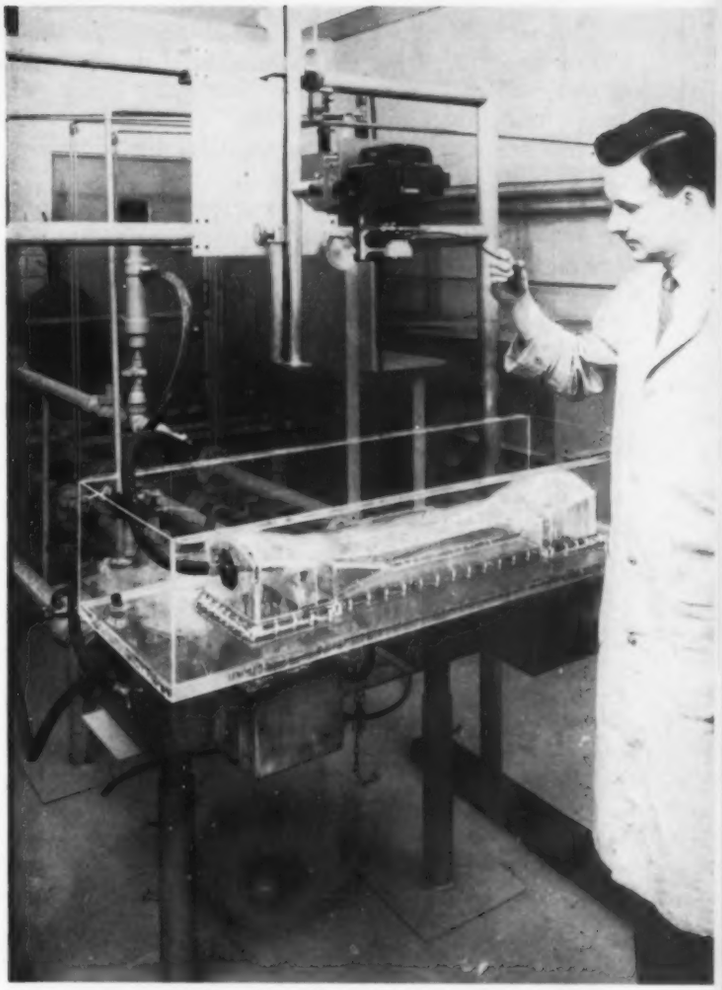
Green River Steel, the only steel company with a new plant established since the war, filed bankruptcy proceedings. Future operational plans are contingent on court decision but company will probably continue as a subsidiary of Jessop Steel Co.

Acme Steel Company purchased the property and net assets of Newport Steel Corp. from Merritt-Chapman & Scott in July. Newport has a capacity of 600,000 tons from open hearth and electric furnaces, as well as blooming and finishing mills for producing hot and cold rolled sheets, electric-weld line pipe and specialties. Newport will be operated as a division of Acme, and some of Newport's ingot capacity of 600,000 tons will be barged to the Riverdale plant. Acme also decided to build its own facilities for the production of billets and slabs to insure an adequate supply of raw materials. It is expected that the expansion at Riverdale will cost about $15,000,000 which takes into account purchase of a second-hand blooming and finishing mill. The company is also considering the use of scrap and pig iron in a basic hot-blast cupola to make hot metal which in turn will be used in oxygen converters, a procedure which will minimize investment.

During the year, H. K. Porter Co., acquired the business of West Virginia Steel & Mfg. Co. at Huntington, W. Va. Operations of this company will be combined with Porter's Connors Steel Div. West Virginia Steel melts and rolls electric furnace steel and rerolls rails; its products include reinforcing bars and mine supplies.

As usual, there were rumors of new steel mills during 1956, but to a much less degree than in the past. Among the new plants mentioned was a $200,000,000 plant in central Montana, to be built by a new firm called Montana Iron Mining. Another new steel company is the Mississippi Steel Co. reported to be planning a 30,000-ton capacity electric furnace plant near Jackson, Miss., at a cost of over $1,000,000. Also still alive are the hopes of Western Empire Steel Corp. to build a 600,000-ton steel plant on the west coast.

Pacific States Steel Corp. of Niles, Calif., recently purchased a blast furnace from the Tennessee Products & Chemical Corp. at Nashville, Tenn. This furnace has a 12-ft hearth and a capacity of about 300 tons a day. Under consideration also is the installation of coke ovens which would make the company the first integrated plant in the San Francisco area, and the second integrated plant on the west coast.



All steel companies are devoting intensive efforts on research to find better ways for making better steels. Plastic open hearth model shown is at U. S. Steel's new research center.

Perhaps the most important new plant proposed for the immediate future is one which Jones & Laughlin Corp. proposes to build near Houston, Texas. Although plans are not definitely settled, rumors indicate that a number of novel steelmaking procedures may be used. Fast tax amortization has been requested. The initial product mix will emphasize oil country goods. One factor which may help J&L obtain a fast tax write-off on this plant is the desire of the Government to disperse the steel industry throughout the country.

Just announced at the year-end were plans of Phoenix Iron & Steel Co., subsidiary of Barium Steel Corp., to build a $75,000,000 fully integrated steel plant in southern New Jersey. A 1000-acre site is being purchased on the Delaware River, between Trenton and Camden. Construction is planned in a step-by-step schedule, with the first phase embracing coke ovens, a blast furnace and oxygen-blown converters. Plans are for an ingot capacity of 800,000 tons.

Many steel-consuming projects now authorized or about to be authorized will take a heavy toll of available steel supplies. Among these projects are the $33,000,000,000 highway program authorized by the president during the year. This alone will take about 50,000,000 tons of finished steel products between 1957 and 1967.

Another item which will keep steel industry busy in 1957 is the construction program which the U. S. Dept.

of Commerce estimates will total about $46,500,000,000 for the year, 5 per cent above the record $44,000,000,000 of 1956. Expansion in practically every field except new private housing is expected.

It appears that the construction activity will set up a very heavy market for buttweld pipe for water, gas, sanitation, central heating and wiring protection. Accompanying the increase in overall demand for tubular products will be demands for higher strength in oil country tubular products. The power and chemical processing industries are asking for steels with high temperature strength and greater resistance to corrosion.

The requirements for wide flange beams have resulted in a number of increases in capacity for producing this product. The new mill of Inland Steel Co. at Indiana Harbor has gone into production and will produce a full range of sizes from 8 to 24 in.

Another product of growing importance is silicon steel. The demands of the electronics and electrical industries are expected to increase and additional facilities have been installed by a number of companies. These include U. S. Steel Corp. at its Vandergrift plant, Republic at its Warren plant, and Armco at its Butler plant. Allegheny-Ludlum is scheduling more than half of its new strip mill at Brackenridge on silicon steel.

Stainless steel continues to find new uses. One of these is its use in aircraft honeycombs. This structure combines good strength-to-weight ratio, and, if it works out, may result in the substitution of considerable stainless where aluminum is now used. The use of stainless for the sheeting of buildings is increasing. A survey during the year showed that almost one-third of all stainless products were sold through distributors, and that sheets and plates account for more than 50 per cent of all sales. The pattern in stainless shows an increasing trend toward warehouse sales, probably because the end uses of stainless are so diversified.

Steel companies are broadening their interest in the titanium field. Republic Steel Corp. bought into a company called Cramet which was formed several years ago by the Crane Company. There are now four steel companies which have heavy interest in the titanium producing field. These are Republic Steel Corp., Allegheny Ludlum Steel Co., Sharon Steel Co., and Crucible Steel Corp. of America.

U. S. Steel Corp. formally opened its new research center at Monroeville, Pa., on May 7, 1956. This is one of the largest and most modern laboratories ever built by the steel industry and is typical of a trend in the industry. Research centers are also holding the attention of Bethlehem, Republic and Crucible Steel.

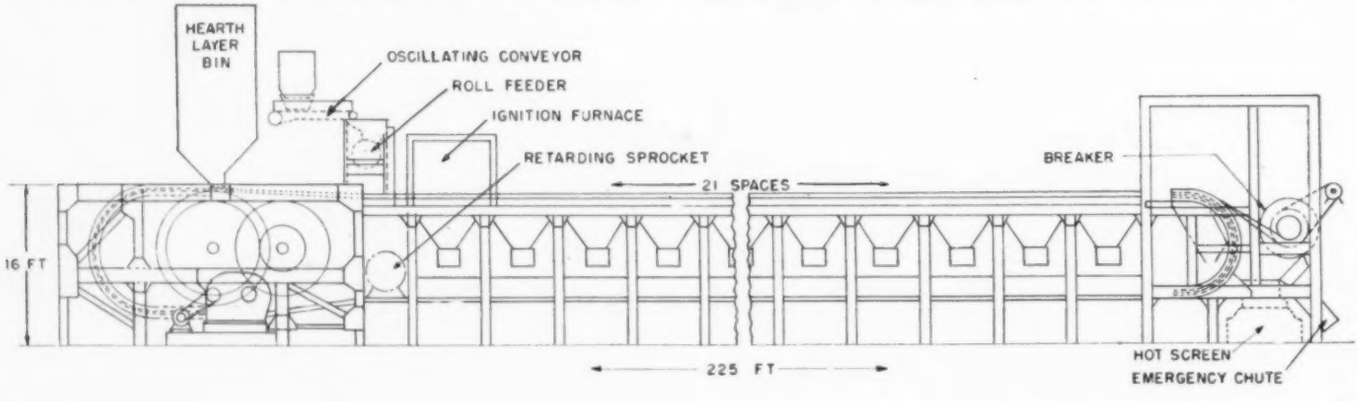
In an attempt to cut their material cost, the can makers are producing more tinplate in coils instead of sheets. While this may not cut overall purchases, tinplate producers will definitely be affected. American Can Co. appropriated $27,000,000 for the installation of new manufacturing facilities to fight rising tin and steel prices. The company started construction at Hammond on facilities to make containers from coil stock. Continental Can Co. has also announced that they plan to buy more tin plate in coils.

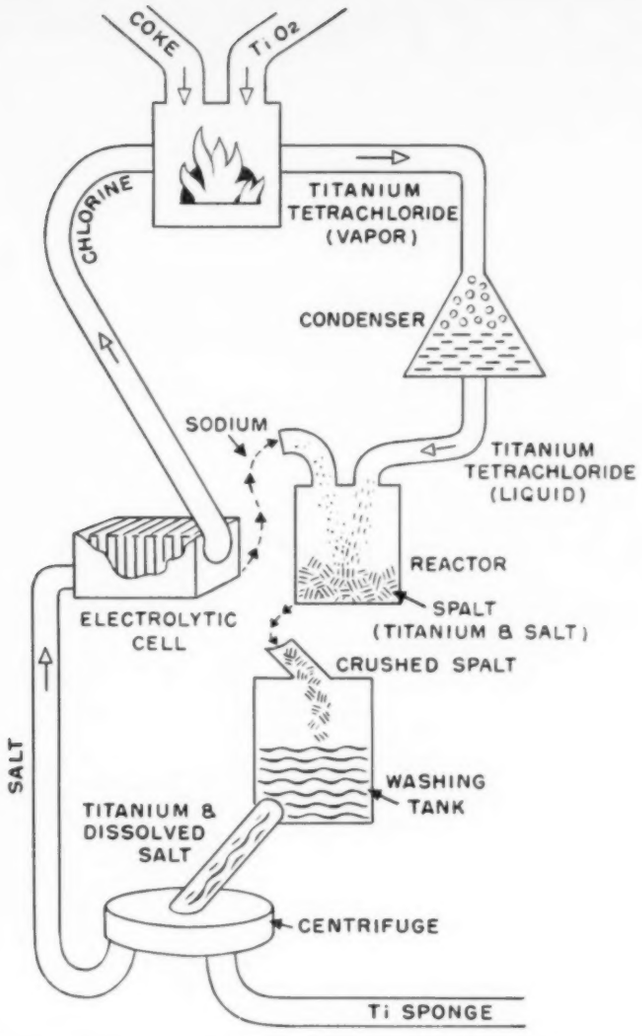
The final strike settlement with the steel workers resulted in an expensive contract for the steel industry. Wages were increased 7.5¢ hourly, plus 0.3¢ increase in increments between job classes. On July 1, 1957, there will be further increases of 7¢ per hr, plus 0.2¢ increase in increments between job classes, and on July 1, 1958, still further hourly increases of 7¢ plus 0.2¢ increase between job classes. Semiannual adjustments in wages to reflect increases in the consumer price index will be made if the index moves above 116.5 and will consist of 1¢ per hour added to straight time earnings for each 0.4 or 0.5 point change in the index. A 10 per cent premium for Sunday work after September 1, 1956, was included. This will be raised to 20 per cent on July 1, 1957 and to 25 per cent on July 1, 1958. Starting July 1, 1957, 2.1-time will be paid for holidays worked. After July 1, 1958, the rate for holiday work will be 2.25. Employees will receive the difference between eight times straight hourly earnings and jury payment for jury service.

The plan for supplementary unemployment benefits is to be negotiated. The company will contribute 3¢ an hour plus 2¢ per hour as a contingent liability when the fund is less than the amount required by the plan. Benefits will apply to employees with two years of service and may extend for 52 weeks, and with state unemployment compensation, can be up to 65 per cent of pay. A new insurance agreement was negotiated which will cost 3¢ an hour more than the present plan. Companies and workers will share cost equally. Added to "paid" holidays is Good Friday. Pension benefits were increased effective November 1, 1957, when they will be raised to $2.40 per month for each year of service before November 1, 1957, and to $2.50 per month for each year of service after November 1, 1957, up to a maximum of 30 years.

Effective Jan. 1, 1958, an additional half-week of

Sintering machine shown at Ohio works of U. S. Steel is one of the many installations going into steel plants.





The sodium reduction process is being used in several new titanium plants.

vacation pay will be given to employees with 3 to 5 years of service, with 10 to 15 years of service, and with more than 25 years of service.

Shift differentials were increased from 6 to 8¢ for afternoon shifts, and from 9¢ to 12¢ for night shifts. Union security was made more stringent; employees who are members must continue membership as condition of employment and new employees must join the union after 30 days on job. The union estimated the three-year gain for steel workers at 45.6¢ an hour, of which the first-year gain is 20.3¢, the second year gain 12.2¢ and the third year 13.1¢. Companies estimate the total costs up to 55¢ an hour for the same benefits.

As a result of the agreement, the 0.1 job classification which, at the beginning of 1956 paid $1.685 an hour will go up to $1.96 an hour by July 1, 1958, and the job classification No. 32 which was $3.545 an hour before the contract will go to $3.97 by July 1, 1958.

Actual steelmaking costs are estimated to go up about 40¢ per ton for every one cent rise in wage cost alone. When the effect of the labor rate on purchased goods and services is included, each cent of wage increase boosts steel costs by 60 cents a ton.

As a result of the strike settlement, prices of steel were increased, on the average, about $8.50 per ton, less than anticipated and less than would be called for by the increase in wage cost. Since the three-year contract calls for further automatic boosts in wages, further price increases may be expected. Rising costs of scrap, coal, freight, etc., will also contribute. However, the contract should give stability to the industry for the next three years. The cost of the strike to the steel industry was about $335,000,000 and the wages lost to the steel workers ran about $250,000,000.

The steel strike also resulted in curtailment of ore shipment down the lakes. Unfortunately this issue was not settled when the steel strike was settled and the strike on the lakes continued against some carriers until the first week of September. As a result, ore shipments down the lake were reduced below requirements and may necessitate extensive railroad shipments throughout the coming winter.

Uncovered by the strike was the fact that the break-even point of steel operations is lower than has often been estimated. Financial statements for the third quarter, which included the strike, showed companies breaking even or making a slight profit at operating rates of about 55 to 60 per cent. When the final results for the year are in, they should compare well with previous years.

Of interest to Great Lakes shipping is a channel-deepening project which has been authorized. This project, which involves some 44,000,000 cu yd of dredging, will deepen the connecting channels on the Great Lakes from Lake Erie to the upper Lakes. Dredging started on the Detroit River in 1956 and is expected to start on the St. Marys River in the spring of 1957. The work consists of deepening channels to provide minimum depths of 24 ft from Lake Erie to the upper lakes. Also of interest to the steel industry is the proposed canal connecting Lake Erie to the Ohio River, which continues to be a subject of conversation.

DETAILED EXPANSION

Expansion of facilities is a chore which constantly faces steel plant management and engineers. No sooner is a plan made and approved before changing conditions make revisions or additions desirable. As a result, to tabulate or list the expansion program of the industry is a hopeless task. Such a tabulation is out of date the day after it is prepared.

The tabulation included here has been obtained from official company releases, annual financial statements, discussions with individuals, reports, etc. Only the larger items are listed. They are items which were either under construction or on the construction schedule in 1956. Items which have a (C) after them were completed in 1956. Items and costs have been allocated against a plant location when possible, sometimes they are given as overall generalized figures. Partial total figure of $2,531,782,500 for expansion comprise items only, with perhaps one or two exceptions, which have been definitely authorized for construction. The tonnage increase of 17,138,000 also includes, primarily, presently authorized construction. The true total figures are greater because there is much expansion in facilities and steelmaking capacity which has not been announced. There are many programs planned and established which are only awaiting go-ahead signals which will come when money and manpower are available.

PARTIAL LISTING OF ANNOUNCED EXPANSION PLANS — 1956

(C) Denotes completion in 1956

Company and plant	*Cost*	*Additional ingot capacity tons*	*Steelmaking facilities*	*Additional iron capacity*	*Ore preparation*	*Hot mills*	*Cold mills*	*Finishing facilities*	*Miscellaneous*
Acme Steel Co. Calumet Harbor, Ill.	$15,000,000	250,000	2-oxygen converter	Cupolas	.....	.....	.....	.....	.....
Allegheny Ludlum Steel Corp. Brackenridge, Pa.	.....	.....	.....	.....	.....	.....	Sendzimir mill	.....	.....
Alan Wood Steel Co. Conshohocken, Pa.	$8,000,000	175,000(c)	1-140 ton OH(c)	Enlarged blast furnace	New 15-ton ore bridge(c)	.....	4-High temper mill (c)	Slitting line(c)	5-Annealing furnaces (c) Crane imp. (c) Office bldg. enlarged
Armco	$246,000,000	.....	.....	.....	.....	.....	.....	.....	.....
Middletown, Ohio	.....	400,000(c) 200,000	2 OH 1-300-ton OH	.....	.....	Hot strip roughing train. Spiral-weld pipe mill	Temper mill	Zinc grip line 1-Pickle line	1-Annealing line
Butler, Pa.	.....	.....	.....	.....	.....	42-In. hot strip mill Wheel mill	3-Stand cold mill 1-Sendzimir mill	1-Pickle line	1-Annealing line Box annealing 1-Decarb line
Ashland, Ohio	.....	.....	.....	1-1400-Ton blast furnace (c)	1-2400-Ton sinter line	.....	1-Reversing cold mill	.....	1-Continuous annealing line
Sheffield Steel Div.	.....	420,000(c)	3-Electric(c)	Enlarge blast furnace(c)	1-1400-Ton sinter line 1-Ore bedding	.....	.....	.....	Mold foundry
Atlantic Steel Co.	$8,500,000	125,000	1-75 ton Electric(c)	.....	.....	21-Stand rod and bar mill(c)	.....	.....	Office bldg.(c)
Bethlehem Steel Co.	$300,000,000	3,000,000	.....	.....	.....	.....	.....	.....	.....
Bethlehem, Pa.	.....	500,000	.....	.....	.....	Structural mill improvement (c)	.....	.....	.....
Lackawanna, N. Y.	.....	500,000	Rebuild 1 OH 1-OH	.....	.....	.....	.....	.....	1-Slab heating (c)
Sparrows Point,	.....	2,000,000	7-350-ton OH	1-Blast furnace	2-2000-Ton sintering lines 2-2000-Ton sintering lines(c)	Roughing mill 45x90-In. slabbing mill 160-In. plate mill Electric weld pipe mill(c)	2-48-In. 2-stand tandem mills 1-48-In. 5-stand cold strip	3-Continuous annealing lines 1-Continuous annealing line(c) 2-Electrolytic tinning(c) 1-Electrolytic tinning 4-Shearing lines(c) 2-Continuous galvanizing lines(c) 1-Continuous pickler	1-65 Oven coke battery 16 Soaking pits Power plant improvement Annealing furnaces(c) Rebuild slab furnaces
Steelton, Pa.	.....	.....	.....	.....	.....	28-In. Bloomer	.....	.....	Rebuild slab furnaces
Bethlehem Pacific Coast Steel Corp. Seattle, Wash.	$25,000,000	175,000	2-100-ton electric furnaces	.....	.....	Merchant mill 32-In. Bloomer Structural mill imp.	.....	.....	.....
Carpenter Steel Co. Reading, Pa.	$3,100,000	16,000	1-Electric furnace	.....	.....	.....	.....	.....	.....
Colorado Fuel and Iron Corp.	$23,000,000	.....	.....	.....	.....	.....	.....	.....	.....
Pueblo, Colo.		115,000 200,000	Enlarge OH 1-250 ton OH			Stretch mill			2-Soaking pits
Buffalo, N. Y.	.....	160,000(c)	Enlarge OH	Enlarge blast furnace	.....	Modernize bloomer Modernize rod mill(c)	.....	.....	New soaking pits
Claymont, Del.	.....	.....	Rebuild OH	.....	.....	Flange presses	.....	.....	New soaking pit
H. K. Porter Co. Connors Steel Div.	$5,000,000	.....	1-Electric furnace(c)	.....	.....	1 Merchant mill(c)	.....	1-Cold draw(c) Improve Finishing(c)	.....
Copperweld Steel Co. Warren, Ohio	$10,100,000	42,000	Electric furnace improvement	.....	.....	20-In. Billet mill 35-In. bloomer	.....	.....	Continuous annealing
Glassport, Pa.	$1,100,000	.....	.....	.....	.....	.....	.....	.....	Soaking pits
Shelby, Ohio	$800,000	.....	.....	.....	.....	Reduction mills	.....	.....	Miscellaneous improvements .....
Crucible Steel Co.	$45,000,000	.....	.....	.....	.....	.....	.....	.....	.....
Midland, Pa.	.....	.....	.....	.....	.....	Heavy plate mill facilities Electrification of bloomer High lift bloomer	50-In. sendzimir	Pickling facilities	Coke ovens Annealing facilities Soaking pits
Detroit Steel Corp. Portsmouth, Ohio	$18,000,000	210,000	1-275 ton OH	.....	1-Sintering plant	Add 2 stands to hot strip	.....	Sheet and strip finishing	4-Soaking pits 1-Flame scarfer
Eastern Stainless Steel Corp. Baltimore, Md.	$5,277,500	.....	1-30 ton Electric	.....	.....	.....	50-In. skin pass	.....	Building cranes
Edgewater Steel Co. Oakmont, Pa.	.....	.....	.....	.....	.....	.....	.....	.....	Tempering and annealing furnace(c)
Granite City Steel Co. Granite City, Ill.	$30,000,000	500,000	.....	1-1200 Ton blast furnace (c)	1-8 Ft sintering line	.....	56-In. Tandem cold strip	1 continuous galvanizing line(C)	2-Batteries soaking pits

Inland Steel Co. Indiana Harbor, Ind.	$280,000,000	..... 300,000(c) 800,000	..... 3–315 Ton OH	 400,000	.....	1–45x90-In. slabbing mill 1–76-In. hot strip roughing train	..... 1–56-In., 4-stand tandem cold mill 1–56-In. temper mill	.....	Main office bldg. 1–87-Oven coke battery(c)
Jones & Laughlin Steel Corp. Aliquippa, Pa.	$360,000,000	 400,000	..... 2–Oxygen converters	..... Enlarge blast furnace to 28 ft 6 in.	..... Sintering	..... Bar mill facilities (c) 2 Continuous weld pipe mills 1 Electricweld pipe mill 44-In. hot strip mill	....	..... Seamless	..... Soaking pits 2–Hot scarfers Oxygen plant
Pittsburgh, Pa.	.....	100,000	.....	Enlarge blast furnace	.....	.....	.....	Continuous galvanizing line(c)	Slab scarfing(c)
Cleveland, Ohio	.....	500,000	OH improvement. 2–125-ton electric	.....	1–2500-ton sintering line	Hot strip mill stand 1–Bloomer 1–Reversing rougher	1–56-In. temper mill 4–Stand tandem mill 1–Sendzimir mill	1–56-In. pickler 1–Shearing line	Oxygen plant(c) 15 4-Stack annealers 6 Soaking pits Hot scarfer
Willimantic, Conn.	.....	.....	.....	.....	.....	.....	.....	Colddraw	.....
Houston, Texas—New integrated steel plant under consideration. Details not yet established.									
Kaiser Steel Corp.	$113,000,000	620,000	2–65-Ton oxygen converters	A 4th blast furnace	.....	86-In. hot strip mill improvement 46-In. slabbing mill Plate mill improvement	2–Temper mills	Electrolytic tinning line 60-In. strip pickler	Enlarge 22, 70-ton soaking pits to 120-tons 8–120 ton soaking pits 1–Continuous annealing line 3–Slab furnaces
Keystone Steel & Wire Co. Peoria, Ill.	$10,000,000	.....	Improve OH	.....	.....	Rod mill Billet mill stands (c)	.....	.....	Add soaking pits (c)
Lukens Steel Co. Coatesville, Pa.	$40,000,000	350,000	1–Electric furnace	.....	.....	Breakdown Mills	.....	.....	.....
McLouth Steel Co. Detroit, Mich.	$2,600,000	.....	.....	.....	.....	.....	.....	Stainless finishing	Oxygen plant Soaking pits
Mississippi Steel Co.	$1,000,000	30,000	Electric	.....	.....	.....	.....	.....	.....
National Steel Corp. Weirton Steel Co. Weirton, West Va.	$275,000,000	1,000,000	..... 1–Converter 1–600 ton OH(c)	....	..... 1–12-Ft sintering line	....	..... 5–Stand cold mill(c)	..... 1–Pickle line(c) 2–Continuous galvanizing lines 1 Electrolytic tin line(c)	..... 4–Soaking pits 1–Continuous annealing line 1–41 oven coke battery(c)
Great Lakes Steel Corp. Ecorse, Mich.	.....	.....	.....	.....	1–ore bridge Ore yard 1–12 Ft sintering line	.....	.....	1–New continuous pickling line 2 Continuous pickling lines rebuilt 1–Slitting line	4–Batteries soaking pits(c) Cover annealing facilities 1–78 Oven coke battery 4–Slab heating furnaces
Northeastern Steel Corp. Bridgeport, Conn.	$9,000,000(c)	112,000(c)	2–35 ton Electric(c)	.....	.....	Merchant bar(c)	.....	Colddraw(c)	.....
Northwestern Steel & Wire Co. Sterling, Ill.	.....	250,000	.....	.....	.....	1–16-In. Merchant	.....	.....	.....
Pacific States Steel Corp. Niles, Calif.	.....	.....	.....	1–12-Ft blast furnace	.....	.....	.....	.....	.....
Phoenix Iron & Steel Co. New Jersey	$134,255,000	800,000	Oxygen converters	Blast furnaces	.....	.....	.....	.....	Coke ovens
Harrisburg, Pa.	.....	.....	1–OH(c)	.....	.....	.....	.....	.....	.....
Pittsburgh Steel Co. Monessen, Pa.	$21,000,000	 180,000	..... 12–OH enlarged	..... Modernize 1 blast furnace (c) Modernize 1 blast furnace	....	..... 1–Six stand 30-In. billet mill	....	....	..... 1–19 Oven coke battery 1–96-In. wire fabric machine
Republic Steel Corp. Cleveland, Ohio	$152,000,000	1,700,000	..... 2–New OH 4–OH enlarged (c)	....	....	..... 45x90-In. slabbing mill 98-In. hot strip mill improvement	....	..... Electrolytic galvanizing line	..... 4–51-oven coke batteries Heating furnaces
Warren, Ohio Chicago, Ill.	....	....	2–24-Ft electric Replace 3–70-ton electric with 3 130-ton electric	....	....	..... 1–16 Stand, 11-In. merchant mill	....	....	Soaking pits(c) .....
Gadsden, Ala.	.....	.....	2–24 Ft electric	.....	.....	Hot strip mill	Tandem cold mill	Continuous galvanizing line	2–Slab heating furnaces Titanium facilities
Canton-Massillon	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rotary Electric Steel Co. Detroit, Mich.	$4,500,000(c) 1,000,000	.....	.....	.....	.....	15 Stand bar mill(c)	.....	Pickling	Annealing
Sawhill Tubular Products Co. Sharon, Pa.	$3,500,000	.....	.....	.....	.....	12–Stand continuous pipe mill	.....	.....	.....
Sharon Steel Corp. Sharon, Pa. Farrell, Pa.	$22,050,000 $6,000,000	358,000 100,000	Enlarge 3 OH 1–Electric furnace	....	....	44-In. bloomer	....	....	....
Dearborn, Mich.	.....	.....	.....	.....	.....	.....	.....	Stainless finishing	.....

PARTIAL LISTINGS OF ANNOUNCED EXPANSION PLANS—1956
(CONTINUED)

Company and plant	Cost	Additional ingot capacity tons	Steelmaking facilities	Additional iron capacity	Ore preparation	Hot mills	Cold mills	Finishing facilities	Miscellaneous
The Stanley Works New Britain, Conn.							1-Sendzimir mill		
The Timken Roller Bearing Co. Canton, Ohio	$3,000,000(c)					Improve tube mill(c)			2-Annealing furnaces(c) Hot scarfing unit (c) Inspection unit
U. S. Pipe & Foundry Co. Birmingham, Ala.				1-1000-ton daily blast furnace					1-30 oven coke battery(c)
U. S. Steel Corp. Gary Works Gary, Ind.		800,000			3-5000-ton sintering lines	44-In. slabbing mill 160-In. plate mill improvement			
Gary Sheet & Tin Gary, Ind.						Hot strip mill	Cold mill	Pickling line Recoil line Shear line	Batch annealing
South Chicago, Ill.		525,000			1-5000-ton sintering line	44-In. slabbing mill Structural mill improvement			
Ohio Works					1-5000-ton sintering line				
Homestead		365,000				Structural mill improvement			Soaking pits
Duquesne		90,000	1-15-ton Electric(c) 1-Electric furnace						
Irvin								Filot vinyl coating line	1-Slab furnace
Edgar Thomson Vandergrift		120,000							10 Cover annealing furnaces(c)
Clairton						40-In. bloomer (electrification)			3-Coke batteries (192 ovens)
Houseville					3-5000-ton sintering lines				
Fairless				1-1600 ton blast furnace	1-4000-ton sintering line				
American Steel & Wire Div. Cleveland, Ohio						1-Rod mill(c)			
National Tube Div. Lorain									1-59 Oven coke battery 1-59 Oven coke battery(c) 9-Soaking pits
Columbia-Geneva Div. Geneva, Utah		380,000	Enlarge 10 OH to 300 tons						Anhydrous ammonia plant 3-Slab furnaces (c)
Pittsburg, Calif.								Electrolytic tinning line	4-Soaking pits
Tennessee Coal & Iron Div.							48-In. 2-stand temper mill		
Vanadium Alloys Steel Co. Latrobe, Pa.						10-In. mill 12-In. mill 16-In. mill			
Wallingford Steel Co. Wallingford, Conn.							26-In. sendzimir		
Washington Steel Corp. Washington, Pa.	$2,600,000						48-In. sendzimir (c)		
Wheeling Steel Corp. Steubenville, Ohio	$100,000,000	270,000				Rebuild hot strip Rebuild bloomer		Shearing line	Soaking pits Continuous scarfer
Yorkville, Ohio							42-In. 5-Stand tandem 2-Stand temper Revamp temper	Trimming line Cleaning line Revamp wash & pickle Litho coat line	Annealing
Benwood, W. Va.						Consolidated pipe finishing			Pipe warehouse
Beech Bottom, W. Va. Factories								No. 2 Continuous galvanizing line(c)	Continuous annealing line(c)
Youngstown Sheet & Tube Co. Indiana Harbor, Ind.	$250,000,000	1,000,000				Seamless tube mill	Tin mill		1-Billet furnace 1-80-Ft. rotary hearth furnace
Youngstown, Ohio									1-76 Oven coke battery 3-Slab furnaces (c)
Partial Totals	$2,531,782,500	17,138,000 (tons)							

FOREIGN PLANTS

Expansion in steelmaking capacity is not confined to the United States. In addition to new expansion for ingots, many of the countries in Europe and the Far East are increasing their capacity for the production of flat rolled products. Plants in all countries are also modernizing their facilities for most efficient production.

Since 1950 the U. S. Government and the World Bank have been backing expansion of iron and steel industries in friendly nations, and almost $1,000,000,000 has been used for this purpose. At the beginning of 1956 countries of the free world had a total ingot capacity of about 251,000,000 net tons which is expected to go up to 300,000,000 by 1960. Countries in the Soviet sector at the beginning of 1956, had a total capacity of 76,000,000 tons which is expected to go up to 107,000,000 tons by 1960. Several American companies are participating in the foreign programs, among them Armco which has for some time been giving technical aid and advice to companies in Germany and Italy. In 1956 Republic Steel also started this type of work.

By 1960 the total world steel capacity will be about 407,000,000 tons. As the total steel capacity increases, the proportion in the United States and Europe will probably be reduced, since expansion in other areas is going on at a greater rate.

In Canada there is much work under way. The Steel Company of Canada has begun a $100,000,000 expansion program. This includes a new slabbing mill, and a second electrolytic tinning line. The Dominion Foundries & Steel Ltd. of Hamilton, Ontario, blew in on November 30, a new $9,000,000 blast furnace which will increase the company's pig iron capacity to 2000 tons per day. This unit is part of the company's $88,000,000 expansion program. Work was also started in 1956 on a hot roughing mill.

At Welland, Ont., a $10,000,000 program is under way which includes an electric-weld pipe mill, a joint enterprise of Page-Hersey Tubes, Ltd. and Steel Co. of Canada, Ltd. Operation of the mill was expected to start at the end of 1956. It is scheduled to make pipe from 20 to 36-in. outside diam with a capacity of 200,000 tons of steel pipe a year.

Algoma Steel Corp. announced at the end of the year that they plan an oxygen steelmaking installation which will boost ingot capacity up to 1,600,000 tons annually. A new blooming mill and plate mill will also be installed to roll ingots up to 40,000 lb to slabs and blooms, and convert slabs to finished plates 96 in. wide. Production is scheduled for early 1959.

Western Canada Steel, Ltd. announced a $2,000,000 project at Vancouver. Future plans include an electric smelter at a cost of $5,000,000. This will be the first Western Canadian steel plant to use west coast ores.

On October 20, Dr. Goergen, president and general manager of Phoenix-Rheinrohr AG of Düsseldorf, Germany, dedicated a new Canadian pipe plant called the Alberta Phoenix Tube & Pipe Ltd., at Edmonton, Alberta, Canada. This is a $6,500,000 installation built for a yearly production of 100,000 tons. The German company has an interest in this plant, as well as in the Canadian Western Pipe Mills, Ltd., in Port Moody, British Columbia.

South of the border, the existing steelmaking capacity at the beginning of 1956 of 3,715,000 tons is expected to rise to 6,700,000 tons by 1960. Some of the larger increases in the program are in Argentina, Brazil, Mexico and Venezuela. Argentina's capacity is expected to go from the present 260,000 to 1,250,000 tons and this includes a new integrated plant. In Brazil, the largest existing company, Volta Redonda, will increase from 700,000 ingot tons to 1,000,000 tons. Plans also call for three other new mills elsewhere in Brazil. Mexico is expanding ingot capacity, as well as finishing capacity. Plans include expansion of two integrated plants and a small plant on the west coast. In Venezuela, a $173,000,000 integrated plant will be built at Puerto Ordaz with initial capacity of 300,000 tons which will be boosted to 421,000 tons. This plant is being built by two Italian companies.

The area in Quebec promises to furnish a number of additional sources of iron ore.

The Export-Import Bank lent Cia Fundidora de Fierro y Acero de Monterrey, S.A. $26,000,000 for an expansion program. New equipment for this plant, to be manufactured in the United States, includes a blooming and slabbing mill, continuous reheating furnace, two soaking pits, a mill for flat rolled products, and a modern open hearth shop with 250-ton furnaces.

The Altos Hornos de Mexico, S.A. of Montclova, Mexico placed a contract for a sintering plant expected to have an initial capacity of 900 tons of air-cooled sinter per day. This will be the first iron ore sintering plant to be installed in Mexico.

A Cuban company, Cabillas Cubana, is planning to reorganize and expand its facilities with the installation of an open hearth which is expected to boost output to 112,000 tons a year.

The second major expansion of the Volta Redonda works in Brazil which will increase the plant's ingot capacity to approximately 1,000,000 tons is being handled by an American firm, who with two other American concerns, will also handle the Argentine plant. On the Argentine program is a 1300-ton blast furnace, a by-product coke oven plant, blooming and billet mills, rail and structural mills, and mills for plate sheet, strip and tin plate. Initial ingot capacity of the plant will be 613,000 net tons yearly and the eventual cost of the plant is estimated at $258,000,000. About $100,000,000 worth of equipment will be bought in the U. S. The Export-Import Bank gave Argentina a $60,000,000 credit to help finance construction.

In Great Britain, steel production in 1956 totaled about 23,000,000 net tons. Labor troubles held back production. The British program for expansion in 1956 contemplated the addition of 1,650,000 net tons of steel. The program approved by the Iron & Steel Board includes several large blast furnaces, electric-arc furnaces, oxygen blowing bessemer plants and a new strip mill. Steel production capacity in Great Britain is to be further increased by more than 3,000,000 tons to 25,000,000 net tons in 1958. Expansion includes substantial capacity for sheet and plate.

A new 4-high, 144-in. plate mill is being built for the Appleby-Frodingham Steel Co. at a cost of $1,400,000. The mill will roll plate up to 12 ft wide, up to 4½ in. thick and with a maximum length of 65 ft. This mill is scheduled for completion in June, 1958.

A new medium width continuous strip mill was built in Brinsworth, England, at an estimated cost of $10,000,000. The mill will produce hot rolled steel strip up to 16 in. wide.

A program to be completed in the middle of 1957 at the Stocksbridge works of Samuel Fox & Co. Ltd., will increase output of high carbon precision cold rolled strip and stainless. This is a $1,800,000 program which includes three mills: a high speed 4-high reversing mill driven through the back-up rolls and two conventional 4-high reversing mills. Also under construction here is a 20-ft electric furnace.

A new basic bessemer steel plant is to be built by the Steel Company of Wales at Port Talbot. This unit will consist of three 50-ton converters using oxygen-enriched blast, and will raise ingot capacity from the existing 2,640,000 to 3,300,000 net tons. All present steel production at this plant is by open hearths. The company also has under construction a new 30 ft-3 in. diam blast furnace, equaling the present world's largest at Great Lakes. This unit will increase pig iron production by 10,000 tons per week.

Early in 1956, the Steel Company of Wales, Ltd., started its new No. 3 blast furnace at Margam works. This furnace has a hearth diameter of 29 ft-9 in. and is the largest blast furnace in Europe.

Steel Company of Wales also has a new 5-stand, tandem, cold strip mill at Velindre. Mill is designed to roll steel strip in tinplate gages at speeds up to 5000 fpm. Work rolls are 42 in. long. Horsepower on five stands and reel total 19,150.

At Richard Thomas Baldwins, Ltd., works at Ebbw Vale, a new 21 and 53 x 42-in., 5-stand, tandem cold mill was installed, as well as a new 2-stand tandem temper mill. The 5-stand mill is designed to run at speeds up to 5000 fpm. The mill has a total of 18,250 hp compared with 5,100 hp on a 5-stand mill installed 17 years ago.

Steel production in France in 1956 totaled about 14,600,000 tons compared with 13,700,000 tons in 1955. In Sweden, steel production in 1956 was about 2,500,000 tons, up 10 per cent from last year. Present plans will add 50 per cent to capacity in Sweden in the next five years.

Heavy expenditures are being made by European companies for capital improvement and the European Community for Coal and Steel expect firms in West Germany, Luxembourg, Belgium, France, Holland and Italy to spend $1,000,000,000 in 1956 compared with $969,000,000 in 1955. Of this, about 51 per cent will be spent on steel plants and 45 per cent for coal and iron ore mines. Another four per cent will be spent for lignite briquette works and lignite coking plants.

The West Germany iron and steel industry plans to spend about $286,000,000 for new plants and equipment in the next few years. This pushes the total West German expansion program to $1,000,000,000 since 1950. The German steel industry expected to produce 25,900,000 net tons of steel in 1956 for an all time record. With the help of the new program, capacity will be 32,000,000 net tons by 1960.

Among the German companies planning major developments is the August Thyssen-Huette Co., which has projected an increase of 1,100,000 tons by the middle of 1958. Present capacity is about 1,650,000 tons. The additional capacity will cost about $67,500,000 and will include a coke oven battery, two blast furnaces, a basic converter, four open hearth furnaces, a blooming and slabbing mill, a semi-continuous billet mill, a bar mill, an electrolytic tinning line and a galvanizing line. Recent additions made by this company include hot and cold strip mills, a blast furnace and a converter.

Other German programs include one by Westfalenhutte of Dortmund where soaking pits will be modernized and a merchant mill will be built at a cost of $2,600,000. The Mannesmann Huttenwerke at Huckingen is enlarging soaking pit capacity at a cost of $800,000. A seamless tube mill will be built by F. Meyer at Dinslaken. The Huttenwerk at Rheinhausen is erecting a continuous roughing mill. Eisenwerke at Muhlheim Meidereich are modernizing their blast furnaces.

In Luxembourg the Soc. Miniere et Metallurgique de Rodange is building a mixer and a fifth basic bessemer, and is enlarging building and handling facilities at a cost of $2,300,000. Belgium will modernize a coke oven plant at a cost of $2,500,000 at S.A. Usines, Gustave Boel. In France, Usinor at Valenciennes and the Soc. Metallurgique de Normandie are installing sintering plants, and Usinor at Denain is increasing its bessemer capacity and converting a blooming mill to a slabbing mill.

An American company was awarded a contract for the design and construction of a blast furnace for the ILVA or Alti Forni E Acciaieri D'Italia of Genoa, Italy, a subsidiary of Finsider. The furnace will be constructed at the Bagnoli plant near Naples. It will have a hearth diameter of 26 ft-6 in., and will have an estimated capacity of about 1300 tons of iron per day. This will be the fourth blast furnace at this site, and is part of a program planned to triple iron production.

The other three furnaces each make about 440 tons per day. At Bagnoli, a new strip mill and tube plant are being built at a cost of $5,400,000. Another program for ILVA at Piombino includes two new open hearths at a cost of $4,400,000.

Steel production in Italy for 1956 was about 6,400,000 tons. Present capacity is about 6,500,000 tons.

An American company was awarded a contract for the construction of two 250-ton open hearth furnaces in Spain. These will be part of a large integrated steel mill to be built at Aviles, at Asturia, by the Empresa Nacional Siderurgica, S.A. This contract supplements another for construction of a 28-ft hearth blast furnace at the same location.

Russia and her satellites have set up their own group to counteract the European coal and steel community. Called the Community of Steel and Allied Industries, or S.O.P.O., this coalition takes in all of the eastern iron and steel plants, coal and iron ore mines, as well as machinery, chemical, oil and cement plants. The plan calls for a common iron, steel, ore and cement market among the Poles, Czechs and East Germans. In the program for 1957 are 14,000,000 tons of pig iron, 17,000,000 tons of steel and 11,000,000 tons of cement.

Russia's sixth 5-year plan, which covers the period 1956 to 1960, stresses technological advances, automation and electrification. Steel output is to be increased from 50,000,000 tons to 75,000,000 tons, and iron capacity will be raised from the present 36,000,000 tons to 58,000,000 tons. Russian steel production in 1956 was about 51,000,000 tons.

One visitor to Russia reported a blast furnace at Magnitogorsk which produces 2000 tons of iron per day and which is operated on a very high top pressure. He was told that 85 per cent of all Russian blast furnaces are now operated with high top pressures. Emphasis on new mills seems to be for those which would produce flat rolled products. A new cold mill for tinplate is being built at Magnitogorsk and there are plans for a new hot and cold strip mill which will roll material up to 117 in. wide. He stated that the Russians are making wide use of oxygen in the open hearth and had been able to raise open hearth capacity by about 25 per cent. The Russians favor open hearth furnaces of 300-ton capacity or over, and some 500-ton furnaces are being built at Voroshilov, Magnitogorsk and Kuznetsk.

Plans for steel plant expansion in India are rather extensive and confusing. A program now under way has a target of 6,000,000 tons capacity, but there has been discussion of future plans to bring ingot capacity up to 18,000,000 tons.

Russia is building a plant for the Indian Government at Bhilai, at Madhya, Pradesh, in central India. This is a $234,000,000 project and will give 1,200,000 tons annual capacity. Major units are three batteries of coke ovens, three 23 to 27-ft blast furnaces, and six 275-ton open hearth furnaces. Rolling mill equipment includes a 45-in. blooming mill, a 36-in. structural mill and a 14-in. bar mill.

In addition to this plant, there are two other plants of about the same size which will be managed by the state-owned Hindustan Steel, Ltd. One of these is to be built by Krupp-Demag at Rourkela. The other plant is the new Durgapur Steelworks to be built in West Bengal by the Indian Steelworks Construction Co. Ltd., a British group. The latter will cost about $224,000,000 and will have an initial capacity in excess of 1,400,000 net tons a year. The plant will produce 400,000 tons of foundry grade pig iron and 870,000 tons of medium structural blooms and billets. It will have three batteries of coke ovens which can carbonize 5700 tons of coal per day, three 27-ft hearth blast furnaces rated 1400 tons a day, two 880-ton mixers, eight 220-ton open hearths, and one 88-ton open hearth furnace. Oxygen is to be used for desiliconizing hot metal in transfer ladles. This plant will also have ten bottom-fired recuperative soaking pits, a 42-in. blooming mill and a 32-in. intermediate mill. Finishing mills include a 24-in. medium structural mill, a continuous billet and bar mill and a merchant mill. The first units are expected to be in operation in 1959 and the last units in 1961.

The World Bank loaned $75,000,000 to Tata Iron & Steel Co. Ltd., for expansion at Jamshedpur. Tata's program, which is being done by an American company, Kaiser Engineers, will boost its capacity from 800,000 to 1,500,000 tons of finished steel products, or in other words, to about 2,000,000 tons of ingots. Several American companies have received contracts for a 1650-ton-per-day blast furnace, two 200-ton open hearths, six 2-hole soaking pits. A German manufacturer has received a contract for a 46-in. blooming mill, a sheet bar and billet mill, and a medium and light structural mill. The entire program will cost about $125,000,000.

In Japan, a second 5-year plan was started in 1956, supplementing the first plan which cost 120,000,000,000 yen and which primarily replaced outmoded equipment. The second plan aims chiefly at increasing production and will cost 130,000,000,000 yen. This includes a 1000-ton blast furnace at Yawata Iron Works and another at the Fuji Iron & Steel Company. At the end of the five years, steelmaking capacity will be increased about 20 per cent. Production in 1956 was over 12,000,000 tons.

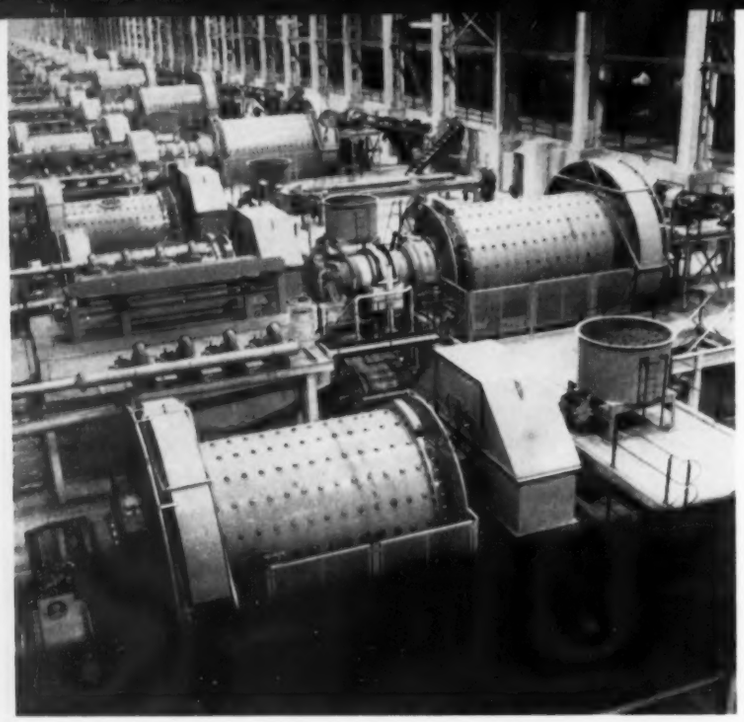
The Fuji Iron & Steel Company are planning several strip mills, one of which is a $12,500,000 installation at its Muroran Works. The Yawata Iron & Steel also plans to increase hot mill facilities. The Nippon Kokan plans a new strip mill, as does the Kawasaki Steel Corp., who received a World Bank Loan for such an installation

RAW MATERIALS

To supply the requirements for raw materials needed by the steel industry is a huge job. Not only must a steady supply of the various materials be provided to meet the constant demand, but additional supplies must be developed to satisfy increasing requirements and to replace depleted reserves. This is difficult since the quantities involved are greater than those needed by any other industry, and many types of material are required from all parts of the world.

In spite of the difficulties, the problem of furnishing raw materials has been met. Shortages which developed because of World War II are either solved or on the way to being solved. New sources have been developed for most materials and lower grade materials are being beneficiated.

Ore—Available ore supplies during the year were affected by a strike against some of the ore carriers which lasted almost nine weeks and seriously interfered



Taconite, ¾ in. in size, is ground to the fineness of flour.

with the normal build-up of ore stocks to last through winter operations. Some 12,000,000 tons of shipment were lost by the strike cutting lake shipments to about 77,586,046 net tons in spite of an extension of the shipping season into December. Total stocks of iron ore, domestic and imported, in the U. S. and Canada as of October 1 were about 59,400,000 net tons. It is estimated that about 77 per cent of the ore consumed in the United States in 1956 was domestic, 10 per cent came from Canada, 10 per cent from South America and the remainder from miscellaneous sources. Total imports are estimated at 39,000,000 net tons, compared with 25,300,000 net tons in 1955.

Some new ore developments are under way in Canada. One still tentative is U. S. Steel's plan to start mining on large deposits of low-grade ore located about 140 miles north of Shelter Bay on the north shore of the St. Lawrence River. Iron Ore Company of Canada is reported planning exploration in the Wabush Lake area. A 35 per cent iron ore is reported to be here. Cyrus Eaton is continuing his work on his Ungava Bay project in northern Quebec. It is also reported that Fenimore Iron Mines Co. has concessions close to the Eaton projects.

In upper Quebec, Jones & Laughlin has options in the Mt. Wright area about 185 miles north of Seven Islands. It is estimated that the deposit, a non-magnetic 32 per cent ore can furnish about 250,000,000 tons of concentrates. Jones & Laughlin is also continuing the search for additional reserves in Ashland County, Wisconsin. Preliminary geophysical surveys have indicated the possible presence of economic quantities of magnetic iron or taconite which might be recovered by open pit mining.

Belcher Mines, Ltd. of Toronto, are doing preliminary work on an ore body on the east side of the Belcher Island group in Hudson Bay. This is reported to be a coarse iron grain ore with a 30 per cent Fe content.

Another source of iron ore lies in the development by Canadian Javelin, Ltd., of leases in the Wabush Lake area. The ore is a low-grade, coarse grained material which can be concentrated to high-grade iron ore. Javelin will build a concentrating plant. Pickands Mather & Co. and Steel Company of Canada have leased a part of Javelin's holdings and expect to get at least 200,000,000 tons of concentrates through open pit mining. Pickands Mather has also agreed to buy up to 2,000,000 tons per year of pellets produced by Javelin.

A new ore project in Venezuela is slated to go into production about 1959. This will be at El Tureno, southeast of U. S. Steel's Cerro Bolivar. A railroad about 125 miles long may be required for this project. Other properties located near Cerro Bolivar may be put into production.

A process developed by International Nickel Co. promises to help the iron ore situation as well as the nickel supply. This process recovers the iron in the pyrrhotite of nickel-iron ores. Iron ore thus recovered is high grade and suitable for open hearth or electric furnace use. The first unit to use the process went into operation at the end of 1955. The first iron ore shipments showed an iron content of 68 per cent. The unit will treat 1000 tons of pyrrhotite per day and produce about 250,000 tons of iron ore per year.

Development by Barium Steel of existing lump ore supplies in the Dominican Republic will increase mining operations from about 10,000 tons to 35,000 tons of ore a month. This ore runs 66 to 69 per cent iron.

Jasper deposits in Michigan, for a long time considered too lean for profitable operations, are now receiving further attention. The Marquette Mining Co. is setting up a plant near Ishpeming, Mich., to process this ore. This is a joint venture of four steel companies and Cleveland Cliffs. The plant will have an initial capacity of 500,000 tons a year which may be quadrupled by 1964. About 70,000 tons of ore pellets were shipped during the last quarter of 1956. At the Humboldt mine, a similar operation, consideration is being given to doubling the output from the current 300,000-ton annual capacity. All of this ore goes to the Ford plant. The concentrate is not pelletized at the Humboldt mine.

Taconite production in 1956 is estimated at 4,500,000 tons, about double the 1955 figure. This is to be increased to about 10,000,000 tons in 1957. In April, first full scale shipments of taconite pellets were started from a 1,000,000-ton stockpile at Silver Bay, Minn., by the Reserve Mining Co. These pellets bring a premium of about $1 a ton over Old Range non-bessemer ores. Erie Mining Co. at Aurora, Minn., is scheduled for full operation of its plant in 1957, although pilot operations have been going on since 1947.

A summary of the present taconite program is as follows:

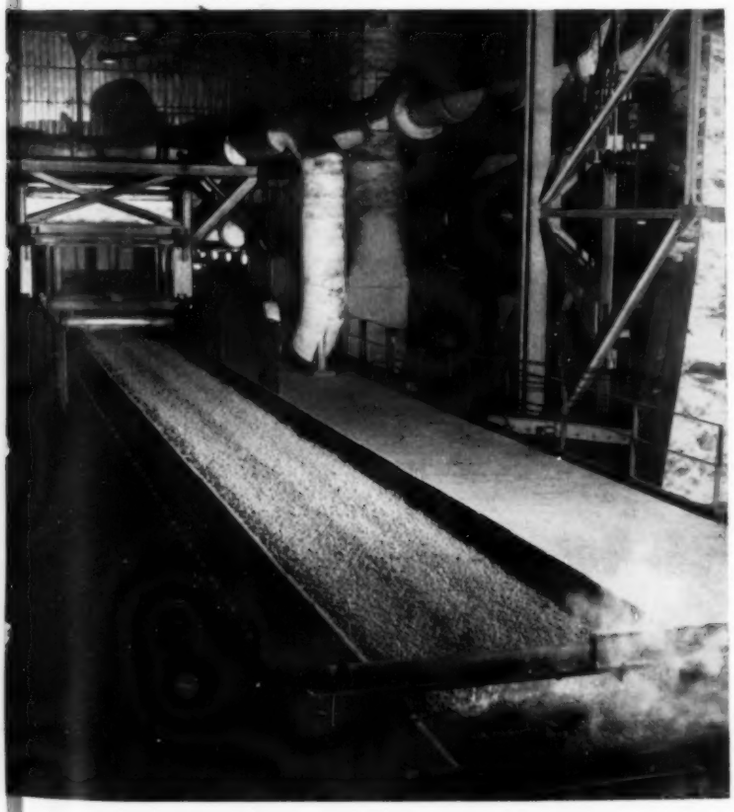
1. Erie Mining Co.—owned by Bethlehem, Youngstown Sheet & Tube, Interlake, and Steel Co. of Canada; located at Aurora, Minn., representing an investment of $310,000,000; to produce 7,500,000 tons of pellets; now scheduled for full production in 1957; planned annual tonnage of 10,000,000.
2. Reserve Mining Co.—owned by Armco and Republic; located at Babbit & Silver Bay, Minn.; representing an investment of $190,000,000; to produce 3,750,000 tons; now in operation at the E. W. Davis Works; eventual plans call for 10,000,000 tons.

3. Oliver Iron Mining Div. of U. S. Steel at Mountain Iron & Virginia, Minn.; an investment of $23,000,000 for a capacity of 600,000 tons; annual production of 10,000,000 tons by 1959 is planned.
4. International Nickel Co. at Copper Cliff, Ont., with a $19,000,000 investment and 250,000 tons capacity. Planned eventual capacity is 1,000,000 tons.
5. Pickands Mather Co., combined with Steel Co. of Canada and Jones & Laughlin at the Hilton Mine, 40 miles west of Hull, Quebec; involves an investment of $16,000,000 and will produce 600,000 tons by 1957.
6. Marquette Iron Mining Co. composed of Cleveland Cliffs, Inland Steel, Jones & Laughlin, Wheeling Steel, and International Harvester; located at Republic, Mich.; investment is $14,000,000 for capacity of 600,000 tons per year. Eventual planned annual capacity is 2,000,000 tons.

The trend to sintering continues unabated, since the process boosts iron production at lower capital expenditure than additional blast furnaces. At the end of the year, there were some 18 new sintering lines with a total annual capacity of 25,000,000 tons under construction. These will increase sintering capacity to about 63,000,000 net tons total when they are added to the 103 machines now in operation.

U. S. Steel Corp. has eight sintering machines under construction, one 4000-ton per day unit at Fairless, three 5000-ton units for Saxonburg, three similar 5000-ton units for Gary, one 5000-ton unit for Ohio works, and one 5000-ton unit for South Works. Bethlehem has purchased four 2000-ton units for Sparrows Point, two of which started in 1956. Armco is putting in a 2400-ton unit at Ashland and a 1400-ton unit at Houston. Jones & Laughlin are building a 2500-ton unit at Cleveland. Granite City Steel will start construction of a plant in 1957.

Pelletizing furnaces bake pellets at 2400 F at Reserve's new ore preparation plant.



Weirton Steel Co., which put in the first machine with an 8-ft wide bed is adding another unit 12-ft wide, and their associate company, Great Lakes Steel, is also installing a 12-ft machine. These units are expected to produce 6000 to 7000 tons of sinter daily. A feature of these plants is the plan to mix limestone with the ore before sintering.

Scrap—Scrap prices mounted during the year with the rise starting as the steel strike ended. These increases created much protest and, as a result, Congress ordered the Dept. of Commerce to make a scrap inventory report which is due in January, 1957. One of the contributing factors was the shipment of scrap abroad totaling about 5,500,000 net tons. The leading importer of scrap was Japan, who took almost 30 per cent of the total. Next in order were Italy, Canada and the United Kingdom. Scrap prices were at an all-time high at the end of the year, having risen to a composite of about $62 a ton, with No. 1 heavy melting scrap at $65 to $67 a ton.

Coal—Coal was not a problem during the year and production actually increased somewhat. An important factor in keeping coal costs down has been the adoption of continuous, mechanized mining machines.

A factor important in the future of coal may be the synthesizing of gas by partial oxidation of coal. A 300-ton pilot hydrogenation plant has been in operation for about three years and results indicate that the optimum size for such units is from 3000 to 6000 tons per day. One company is planning a low-temperature carbonization plant near Cresap, W. Va. They expect to get more and better coal chemicals than from the by-product coking process.

In Colorado a $100,000 pilot plant is under construction for developing and pilot testing processes for extracting oil from western shales. This plant will have a rated capacity of 1000 tons of shale a day and should yield an estimated 17,000 gal of oil.

Manganese—Last year it was reported that a large deposit of low-grade manganese ore had been discovered near Woodstock, New Brunswick. It is believed that there are some 200,000,000 tons of ore in this area containing an average of 11 per cent manganese and 13 per cent iron. A pilot plant was put into operation with a new method of recovering the manganese and a full scale plant is planned for a capacity of 75,000 tons of ferromanganese annually. A feature of the process is an expected 95 per cent recovery compared with 80 per cent recovery in conventional practice. In addition, about one ton of ingot iron will be produced for each ton of ferromanganese.

A unique process for removing manganese from basic open hearth slag first converts the slag into an acid slag by the addition of silica in an electric furnace. Subsequent addition of carbon partially reduces the slag until the iron content is lowered to 5 to 10 per cent while a metallic bath forms under the slag consisting of the reduced iron with very little manganese but nearly all the phosphorus and sulphur. The manganese stays in the slag because of the slag's acid nature. The refined slag can then be used as material from which to recover manganese in a form suitable for metallurgical use, or

the slag may be used directly in the open hearth furnaces.

A Bureau of Mines report showed that low-grade chrome ore from Grand County, Oregon, can be smelted to give a ferrochrome-silicon. The economics of the process, however, have not been determined.

Tin—There was no particular problem with tin during the year. Production was pretty well in line with the demand with a tonnage of about 176,000. However, late in the year, the Suez crisis threatened the supply, since much of the Malayan tin comes to the U. S. through the canal. As a result, tin prices rose from about 98¢ in the middle of the summer to $1.14 by November 1.

Nickel—If any material was short during the year, it was nickel. Free world production of nickel in 1956 was estimated at about 445,000,000 lb, a gain of about 50,000,000 lb over 1955. Requirements in the United States were about 300,000,000 lb, of which as much as 40,000,000 lb may have gone to government stockpiles. The Bureau of Mines estimated nickel production will go to 606,000,000 lb by 1960. New sources which promise to become important are in Cuba, New Caledonia and Canada. The United States Government, however, is hoping that nickel supplies available in the United States will go up to about 440,000,000 lb by 1961. To encourage this, it is planned to pay premium prices to cover production costs to foreign and domestic firms who expand nickel output. The Office of Defense Mobilization announced late in the year that it may drop all stockpiling if private industry provides new nickel capacity. The shortage of nickel, however, is expected to continue through 1958.

The project for producing nickel at Nicaro, Cuba, grew from about 30,000,000 lb annual capacity to 50,000,000 lb in 1956. The M. A. Hanna Company plant at Riddle, Oregon, produced about 16,000,000 lb of ferronickel in comparison with about 6,500,000 lb in 1955. A new nickel refinery belonging to National Lead Co. started operation in September at Crum Lynne, Pa. This plant can turn out 14,000,000 lb of nickel a year, using ore from Cuba. In December, 1956, the International Nickel Co. announced a 9½-cent price increase, bringing the price to 74¢ per lb. At the same time, they announced plans to develop a new nickel producing operation in northern Manitoba at a cost of $175,000,000. The new mine, plus expansion at Sudbury, will lift the company's annual capacity to 385,000,000 lb.

Zinc—Zinc was in adequate supply during the year, with consumption about 995,999 tons compared with the record 1,078,968 tons of 1955. Production of steel base galvanized products in 1956 was about 2,750,000 tons.

A zinc ore body was discovered in Brazil which may prove to be one of the world's major deposits. There is also copper in the deposit.

Aluminum—Aluminum production in the United States in 1956 is estimated at about 1,683,000 tons, a 7 per cent increase over 1955. This was accomplished in spite of a strike similar to the strike against the steel industry. Primary producers increased their annual capacity 125,000 tons in 1956 to 1,762,000 tons. In the next two years this will be further increased by about 42 per cent. In addition to American production, about 40 per cent of Canada's aluminum production, or 250,000 tons was imported into the United States.

Aluminum capacity in Canada is now some 732,000 tons and is expected to reach 1,100,000 tons by 1960. Of this, over 1,000,000 tons will be operated by the Aluminum Company of Canada, who are expanding their Kitimat, B. C., plant from 150,000 to 330,000 tons and adding 150,000 tons of new capacity in the Saguenay Valley of Quebec. British Aluminum, Ltd., is also going into production with the construction of an 80,000-ton reduction works at Baie Comeau, Quebec.

The following summarizes the major aluminum expansion projects:

Aluminum Co. of America is building a 150,000-ton aluminum reduction plant at Evansville, Ind., scheduled for operation late in 1957. They are also carrying out an 86,000-ton expansion of smelting capacity in Texas and Washington. The firm's overall capacity will be up to 962,500 tons in 1958.

Reynolds Metals Co. is building an entirely new aluminum reduction plant of 100,000-ton capacity at Listerhill, Ala., and the original plant is being expanded by 20,000 tons. The company will have 575,000 tons capacity by late 1957.

Kaiser Aluminum & Chemical Corp. is building an aluminum reduction plant at Ravenswood, W. Va., with an initial capacity of 125,000 tons and plans for early expansion to 220,000 tons. Kaiser is also expanding its Gramercy plant in Louisiana by 27,500 tons. By the end of 1958, the firm's capacity should be 682,000 tons.

Olin-Revere Metals Corp. has a plant under construction at Clarington, Ohio, which will come into operation in 1958 with a capacity of 180,000 tons.

Harvey Machine Co. is going ahead with plans to get into primary production of aluminum with the construction of a reduction works at The Dalles, Oregon. This plant will have an initial capacity of 54,000 tons, to which another 13,000 tons will be added in 1958.

Adjacent to Kaiser's Ravenswood reduction plant is a $100,000,000 sheet and foil mill with an annual rated capacity of 169,000 tons of aluminum sheet and foil products. Equipment for this plant will include a 168-in. hot reversing mill, a 110-in. hot reversing mill and a 100-in. 5-stand, 4-high continuous hot mill. Cold rolling facilities include a 72-in., 2-stand tandem mill, a single stand 72-in. mill, and a 60-in light gage mill. Foil rolling equipment includes one 72-in. and three 60-in. mills. Extensive facilities for rolling aluminum plate are also planned, including a new 144-in. plate mill, and heat treating and finishing facilities.

Magnesium—It was estimated that primary production of magnesium in 1956 was 66,000 tons. In 1957 this should go up to 79,000 tons. A new producer in the field will be the Alabama Metallurgical Corp. of Selma, Ala., with an initial capacity of 10,000 tons annually. The only other plants in operation are Dow Chemical Company's 25,000-ton plant at Freeport, Texas, and the Government-owned 50,000-ton plant at Belasco, Texas.

Titanium—Titanium capacity increased during the year. The four steel companies now actively engaged in the field are Sharon Steel, Crucible Steel, Republic Steel and Allegheny Ludlum, all working jointly with other metallurgical companies. Titanium production in 1956 totaled 14,500 tons of sponge, 11,500 tons of ingots and 5,300 tons of mill products. Imports of sponge from Japan totaled 1750 tons during the year.

The price of titanium sponge was cut three times during the year and by the end of the year had gone from $3.45 to $2.75 per lb. At the same time, the prices of mill products were reduced.

Titanium Metals Corp. of America announced the purchase of an old steel plant at Toronto, Ohio, and will convert it into a specialized facility exclusively for rolling and forging titanium. The company also announced that they will expand ingot capacity in the Nevada sponge plant from 6000 to 9000 tons yearly.

Crucible Steel Co. started a program at their Park Works in Pittsburgh which is expected to double their capacity for the rolling of titanium sheet.

The Bureau of Mines has a refining process under development which may help cut titanium costs. It has developed an electrolytic method of producing high purity titanium from scrap metal. Up to the present time there has been relatively little work done on the recovery of scrap.

The Ashtabula plant of Electro Metallurgical Co. produced its first heat of titanium metal sponge by a method other than the magnesium reduction process. This was done by a sodium-reduction process. The plant has a capacity of about 7500 tons of titanium sponge a year.

Another company, the U. S. Industrial Chemicals Co., announced that they will put into operation by the end of 1957, a 5000-ton per year plant for the production of high quality titanium sponge. This plant will be located at Ashtabula, Ohio, where the company will also have a 750-ton a year zirconium plant. This plant will also use the sodium reduction process for which claims are made that it can make titanium sponge at a cost lower than existing commercial techniques.

The new Cramet unit at Chattanooga, Tenn., will have a capacity of 6000 tons of titanium sponge annually.

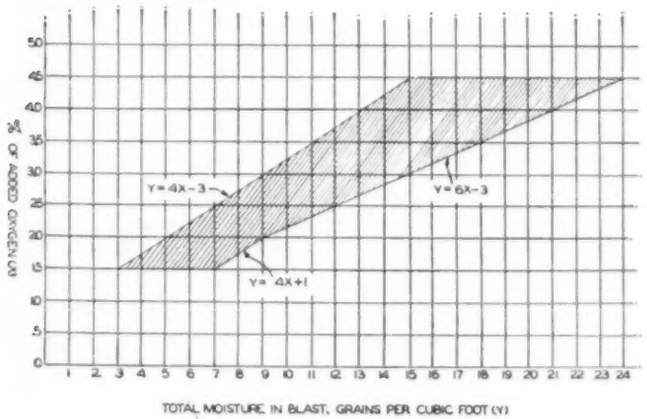
At the end of the year, Allied Chemical & Dye. Corp. and Kennecott Copper Corp. formed a new company to produce titanium with an initial investment of $40,000,000. Production will start late in 1958. The continuous sodium reduction process will be used.

Zirconium—Allegheny Ludlum Steel Corp. completed a 100 per cent increase in zirconium production capacity by installing a new furnace for melting high purity zirconium at its Watervliet, N. Y., plant. The furnace can produce a 2200-lb ingot and has a rated capacity of 50,000 lb per month. An even larger furnace should be in operation now raising ingot capacity to 125,000 lb per month. The Carborundum Co. has increased its capacity at Parkersburg, W. Va., for the production of zirconium from 325,000 to 1,500,000 lb per year.

Copper—Copper, which was in short supply at the beginning of the year and which then sold at record prices, found itself at the other extreme by the end of 1956. During the year, demand dropped and the metal became plentiful. As a result, prices dropped during the year to about 35¢ per lb. Production was cut back at a number of mines.

Tungsten—Tungsten was in good supply during the year. Domestic production in 1956 was about 8000 tons and imports during the year totaled about 11,000 tons. Some 6000 tons were used by industry, and a large portion of the rest went into government stockpiles.

Shaded area shows effect of moisture in blast on operation of blast furnace.



BLAST FURNACES AND COKE PLANTS

Although the steel industry is making strong efforts to increase capacity, this is not reflected in blast furnace construction. Very few, if any, companies have announced major additions to the number of blast furnace stacks. However, additional blast furnace capacity will be achieved through improvements and changes in the operation of existing units.

Perhaps the most important factor is the increased use of sinter. One company which is increasing its steelmaking capacity by 1,000,000 tons is depending on the use of 50 per cent sinter in the charge to increase their iron-making capacity by 25 per cent. Other factors which will increase iron production are better preparation of ore charges, use of higher concentrate ores, use of pellets, use of oxygen, high top pressure and humidity control.

Granite City Steel Co. put a new blast furnace into operation in July which has a daily capacity of 1200 tons of pig iron. The unit stands 229 ft-4 in. high and has a hearth diameter of 25 ft. The working volume between the iron notch and the closed bell is 43,900 cu ft. One of the interesting features of this job was the moving of a 635-ton, 172.5-ft high blast furnace shell a distance of 84 ft on steel rollers horizontally and then lowering it 3 ft-4½ in. onto its steel foundation columns. It was estimated that this procedure resulted in the saving of a month to six weeks in downtime on the unit.

Another furnace which was rebuilt is the Bellefonte unit at Armco's Ashland, Ky., plant. This job was done at the end of the summer and took about two months. Hearth diameter is 27 ft-3 in., and the furnace has an output of 1400 tons of pig iron a day.

Last January, the largest blast furnace in Europe was blown in at the Margam Works of the Steel Company of Wales. This unit has a hearth diam of 29 ft-9 in. and a capacity of more than 10,000 gross tons per week. The furnace is 242 ft high, has a working volume from the tuyeres to stockline of 53,975 cu ft, has 21 tuyeres and a daily capacity of 1500 tons. The furnace has a refractory brick hearth with carbon side wall to the slag notch level. Heating surface of each stove is 330,000 sq ft. Air for the furnace is provided by a 125,000-cfm axial-flow turboblower. This is the first steam-driven, axial-flow blower to be used in England. A new coke plant consisting of 90 ovens was put into operation a few days before the furnace was blown in.

A paper given before the American Iron & Steel

Institute this year by C. M. Squarcy and R. J. Wilson illustrates the present thinking in obtaining additional pig iron capacity. They report that, before constructing new furnaces, Inland Steel Co. considers the following possibilities: (1) beneficiation of ores; (2) use of better coke; (3) high top pressure operation; (4) introduction of steam into blast; (5) introduction of oxygen into blast; (6) preheating blast above conventional temperatures.

Some of the conclusions attained from Inland studies follow: A 9 to 18 per cent decrease in coke consumption may be expected with up to 40 per cent sinter in the burden. Production can be improved from 7 to 20 per cent by increasing sinter up to 40 per cent. Coke consumption and production rate can be improved by using sinter above 40 per cent, but the improvement is not as marked as that up to 30 per cent sinter. Where the coke is strong and the ore is coarse, sinter is less beneficial, but with weak coke and/or fine ore, sinter is quite beneficial. High top pressure has little effect on coke rate or flue dust production. However, top pressures up to 12 psi can increase iron production by about 15 per cent.

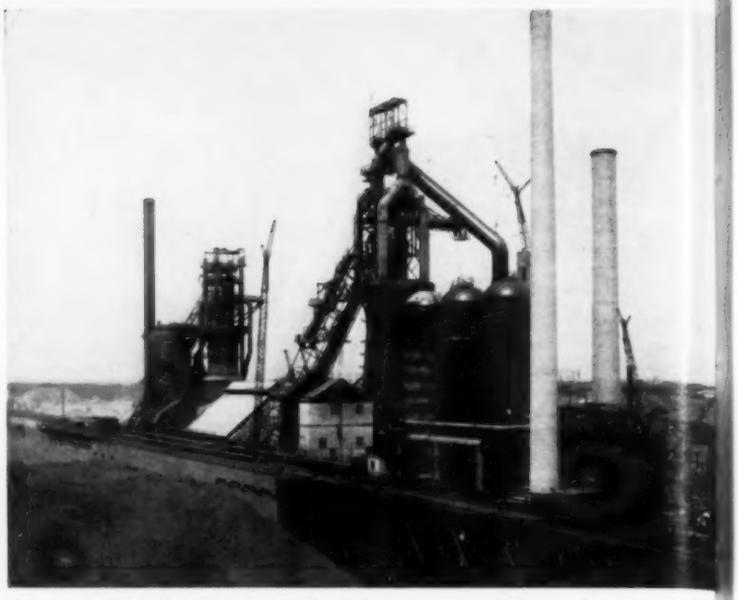
There is a trend toward controlled injection of steam in the blast with the advantages of more uniform blast analysis, production of more hydrogen (an active reducing agent for iron ore) and a smoother working furnace. However, the reaction is endothermic, and there are therefore objections to large volumes of steam unless excess heat is available. Steam can sometimes be used in conjunction with oxygen which tends to give increased temperature and heat. With this combination, the driving rate of the furnace can be increased very appreciably.

Between 1947 and 1956, Inland Steel Co. has gained the equivalent of an additional blast furnace from increased production from their existing eight furnaces; daily operation has gone from about 7350 to 8600 net tons. Much of the credit for this, however, is due to careful blending of coking coals, coal washing and increasing the percentage of sinter and sized ore in the burden. Another small increase is believed to be due to chemical improvements such as lower ash coke and lower slag ore. As an example, two 25 ft-9 in. hearth furnaces obtained a 23 per cent gain in production with a 16 per cent increase in wind rate, although the slag volume increased 11 per cent. Inland has used blast temperatures of up to 1500 F in tests and found that an average of 1200 to 1400 F decreased coke rate by as much as 10 per cent.

Preliminary data indicate that Inland will start operation of a unit with steam-oxygen enrichment of the blast, using a 30 per cent oxygen enriched and 8 per cent steam air mixture.

One steel company is also planning some innovations in the operation of a blast furnace next year, in a unit which will combine high top pressure with a combination of steam and oxygen in a high temperature blast. It is expected that output will be increased a minimum of 20 per cent. Other operating features will be ore beneficiation through sizing and agglomeration, and coal blending and washing. It is estimated it will cost $1,000,000 to adapt the furnace to high top pressure operation.

A report on Weirton Steel's operation of its blast



Granite City Steel's new blast furnace was blown in on July 17.

furnace with oxygen enrichment was given during the year. The results are very impressive. The use of oxygenated air gives increased iron production with a lowering of the cost above materials. The increased tonnage which is obtained with no increase in gas velocities in the stack results in a proportionate decrease in flue dust in pounds per ton of iron. With a coke savings of 25 to 50 lb per ton of iron with two per cent oxygen enrichment, the top gas temperature is about 50 F less and cooling losses, etc., are reduced per ton of iron with greater throughput. The carbon monoxide to carbon dioxide ratio is maintained in about the same proportion with oxygen enrichment as with normal air. There has been no detrimental effect noted on hearth, bosh or stack linings because of the oxygen enrichment.

The use of oxygen has been found to increase iron tonnage in proportion to the enrichment of the blast, and with 1.5 per cent enrichment there is a seven per cent increase in the equivalent wind volume and a seven per cent increase in iron tonnage. With a two per cent enrichment, the increased wind volume of 9.5 per cent results in a 9.5 per cent tonnage increase. As a result, a 76,000-cfm wind volume gives results equivalent to 83,300 cfm of normal air, but the stack velocities are equal to those obtained with the 76,000 cfm of normal air. Tests have been made at this plant using up to three per cent enrichment. However, due to the limited oxygen supply, they found it better to spread the available oxygen over all of the operating furnaces rather than to concentrate it on one. Some 65 tons of oxygen per furnace are required per day for each per cent of enrichment. Top gas is also found to have a higher Btu content, since nitrogen content is less. A typical furnace might have top gas of about 90 Btu per cu ft, but with a 2 per cent oxygen enrichment, the heating value goes up to about 100 Btu per cu ft, giving the blast furnace a greater gas credit. Savings also occur in the steam needed by the turboblower. It is estimated that the oxygen cost, including amortization of the plant, is well under $5 a ton.

Weirton Steel also installed complete moisture con-

trol equipment. This enables them to control the melting zone in the blast furnace to control sticky furnace operation and thus maintain a free flow of gases up the stack. The automatic system is used to give control of the low and high pressure steam which is introduced into the system to control moisture. With two per cent oxygen enrichment, the moisture is controlled to give about 7 gr per cu ft in the turboblower discharge. As the oxygen enrichment is increased, the moisture content is also increased. It was found that steam is a cheap means of introducing additional oxygen into the furnace. With steam at $1 a ton, the oxygen delivered to the blast furnace by moisture dissociation costs only about $1.14 per ton of oxygen.

One operator estimates that by 1960 Lake Superior ores will constitute only about 45 per cent of total requirements, while high-grade imported ores, mostly from Quebec, Labrador and South America will be 30 per cent. Pellets from Minnesota taconite and Michigan jasper will approximate 13 per cent of the total.

The reduction in slag volume which will result from the use of high grade raw materials should give a reduction in coke rate and an increase in furnace output. Much work will still be needed to develop optimum practice and the most economic balance between coke rate and rate of production. Based on data now available, there are certain indications of what the results may be. The Canadian ore from the Quebec-Labrador area has a higher natural iron content than Mesabi ores and the silica content is about one-half. A typical Labrador ore will average about 54 per cent iron and about 5 per cent silica. Operating results with about 40 per cent Labrador ore in the burden show an increased iron production of about ten per cent, a decrease of almost 300 lb in limestone, and a decrease of over 100 lb of coke per ton of iron. This indicates a reduction in slag volume of 330 lb per ton of iron or to about 800 lb per ton. Under such conditions, proper desulphurization may be a problem unless a low sulphur coke is used. Based on Weirton's experiences with a 40 per cent Labrador burden, a burden made up of 50 per cent Labrador ore and 50 per cent Lake Superior ore should give a 12 per cent increase in iron production and a reduction of 9 per cent in coke rate.

The use of Venezuelan ore also creates some unusual operating conditions. This ore is high grade, having about 50 per cent iron on a natural basis, with silica from 0.4 to 2.3 per cent, and alumina from 1.0 to 1.7 per cent. One eastern plant operating on 65 per cent Orinoco ore and 35 per cent Peruvian ore has found that slag volume is about 400 lb per ton of iron. To this, they have added gravel to produce a slag volume of about 600 lb of iron and to obtain an iron with 0.035 to 0.040 per cent sulphur. An excellent coke is used, and the coke rate is about 1370 lb per net ton, about 16 per cent less than that of a normal burden with Lake Superior ores. Because of the high alumina content in the Orinoco ore, the alumina content of the slag has been high (17 to 18 per cent), and dolomite is used as a flux to give a similar amount of magnesia in the slag. This slag composition gives a satisfactory melting temperature and viscosity to promote desulphurization.

As a result of developments in enrichment and beneficiation, it is estimated that by 1960 the average coke rate of the industry will drop to about 1631 lb, 10 per cent under the present rate.

An interesting report told how Inland Steel Co. banked a blast furnace so successfully that the stock movement was held to 2 ft in 55 days. Before banking, the bosh section and mantle circle pipe were washed down with high pressure water. After banking, the tuyere pipe unions were swung away from the bosh but no bulkheads were placed in the tuyere openings. A spraying material consisting of a vinyl plastic was sprayed in layers over the entire bosh and hearth section. When the furnace was blown in, it was only necessary to slit the plastic with a knife to peel it or melt it away with a gas torch.

In tests made by the Bureau of Mines in a 3-ft blast furnace using prepared ores and coke anthracite mixtures, results indicate that anthracite can be used as blast furnace fuel up to percentages of 40 for Mesabi ores and up to 60 per cent for prepared ores. Taconite pellets and coarse ore-sinter mixtures were smelted at fuel rates of 1450 and 1700 lb per net ton compared with 2000 lb per ton required for Mesabi ores.

A European development that has interested American operators is mechanical stove changing, with stoves for one or more blast furnaces handled together in one control room. In one case, four furnaces with 12 stoves are controlled from one central room. Great dependability is obtained in this mechanization, because all the valves work in fully interlocked sequence, and the time taken for reversals is very short. Since it is simple to change stoves as often as necessary, checker work is not cooled as much and the disadvantages of thermal shock in the stoves are avoided. Also, stoves can operate at a very high temperature level. In some plants in Europe, blast temperatures reach up to 1750 F.

Blast furnaces in Russia are also using constant humidity in the blast as a result of some research work from which they concluded that the efficiency of a blast furnace rises as the absolute humidity of the blast is increased, provided that the temperature of the hot blast is raised to make up for the heat expended on decomposing the moisture in the furnace. They also found that each six gr of moisture per cu ft increased productivity by about four per cent and reduced coke rate by one to 1½ per cent. The furnaces which have been adapted for this operation have been fitted with automatic regulators which maintain a given degree of humidity, usually from 12 to 15 gr per cu ft according to the stove capacity. Steam is introduced into the blast main before it enters the stoves. Their work has also shown that increasing the blast humidity up to 18 gr per cu ft does not increase the hydrogen content in the pig iron samples.

Other work done by the Soviets on blast furnace operation indicates that the use of a fluxed sinter with about 0.75 basicity can lead to a reduction in coke rate and an increase in productivity. The use of 36.6 per cent of fluxed sinter, for example, gave a three per cent reduction in coke consumption, and 5.5 per cent in productivity. Many of the furnaces in Russia use top pressures averaging about five psi.

The East Germans are successfully reducing iron in the low shaft furnace with lignite coke. Some ten low shaft furnaces are in operation producing 700 tons of foundry iron per day.

A radical development in ironmaking is the new H-iron process which offers a possibility for increasing blast furnace capacity without the investment cost required by conventional equipment. It is reported that serious consideration is being given to the process by at least one company who plans a new plant in an area where natural gas is available at a low cost. In this process, high pressure hydrogen is passed through iron ore which is reduced directly to iron. The resultant product is free from the carbon and sulphur normally acquired from the coke in the blast furnace. Reduction takes place at a relatively low temperature. The iron powder and the water can be drawn off without interrupting the reaction, although the process is essentially a batch process. The process is operated at about 900 F to prevent agglomeration of the iron. As a result, the fines stay suspended in the turbulent flow of gas. At low temperatures, only a small amount of the hydrogen would ordinarily combine with the oxygen in the ore, but raising the pressure to about 400 psi increases the reaction rate.

The process will only remove oxygen from the ore. Ores which are high in silica or phosphorus will give an iron that is high in these elements. From a good clean ore, it is possible to produce 95 per cent metallic iron which would be suitable for charging into an electric furnace or open hearth.

For the past two years, a pilot plant has produced about 7 tons of iron per day. The plant has processed a total of about 1000 tons of Venezuelan ores and 1000 tons of Swedish ores. The product of this operation is an iron running from 87 to 95 per cent Fe, with phosphorus of 0.039 to 0.048 per cent and with sulphur of 0.01 to nil. In this process, carbon is reduced, sulphur is reduced, but phosphorus, silicon and manganese are not touched. It is estimated that a hydrogen reduction plant to produce 500 tons per day of this material would cost about $8,000,000, a 1000-ton per day plant $12,000,000, and a 2000-ton per day plant, $24,000,000. The cost above ore, not including carrying charges, would be $11 per ton for the 500-ton plant, $9.70 per ton for the 1000-ton per day plant, and $8 per ton for the 2000-ton per day plant. With ore at $22, this appears to make a very attractive charge metal, low in sulphur and without tramp alloys. This process is, however, best suited therefore to ores that are not high in silicon or phosphorus.

Ores that contain too high a percentage of inerts are basically unsuitable for the H-iron process. Therefore, an important factor will be the availability of the right kind of ore. Much of the Venezuelan ore is suitable for the H-iron process, and companies which have access to such an ore are in a better position to adopt the process.

A number of basic hot blast cupolas are being operated in Germany to provide hot metal for steel plants. A number of others are under construction. This cupola is carbon-lined, and has water-cooled tuyeres in place of the plain pipes used in cold blast cupolas. Fumes and dust typical of the cold blast cupola stacks are completely absent in the hot blast design. About 55 per cent of the gas produced (which has a calorific value of 69 Btu per cu ft) is required to heat the blast and the surplus is available for other uses. The hot blast cupola uses a 100 per cent steel scrap charge, but can use the cheapest obtainable grade of scrap. It can also use furnace coke whereas the cold blast cupola requires high-priced foundry coke. It uses 30 per cent less coke than the cold blast cupola on comparable blast charges.

A new process to desulphurize pig iron has been practiced in France, consisting of injection of a dense stream of powdered lime in an inert gas such as nitrogen, or a reducing gas through tuyeres immersed in the metal bath. Molten pig iron is poured into the ladle, the tuyeres of which remain uncovered during this filling phase. After the ladle has been transferred to the place where the treatment is carried out, the tuyeres are connected to the gas supply which is to carry the lime. As soon as a cloud of lime appears, the tuyeres are immersed for three to five minutes by partially turning the ladle on its horizontal axis. The tuyeres are then brought back to the uncovered position and disconnected. Tests show that, with a weight of injected lime equal to about two per cent of the weight of the metal, the sulphur content was reduced from 0.100 per cent to less than 0.010 per cent in three to five minutes.

In the coke plant area of the steel plant, operators are continually raising the efficiency and production of coke plants by tearing down old batteries and replacing them with more modern, more efficient units. These changeovers are tempered, however, by the necessity of keeping sufficient batteries always in operation to satisfy blast furnace requirements.

In the by-product end, the year was marked by announcements of new processing techniques which are being adopted to minimize stream and air pollution, and to meet the requirements of the chemical users who are constantly calling for purer and more refined products.

In May, Republic Steel Corp. announced plans to rebuild four old 51-oven coke oven batteries at their Cleveland plant over the next five years in a program which will cost about $20,000,000. Work was started during the year on the first of the four batteries. Rebuild of each battery will take about a year. Republic now has six coke oven batteries in the Cleveland district with 405 ovens. The two batteries not in the program are relatively new.

National Tube Division of U. S. Steel announced that it plans the construction of a new coke oven battery of 59 ovens at the Lorain Works. This will be the seventh addition to the coke plant since a modernization program started in 1946. The battery will carbonize approximately 1100 tons of coal a day. This new battery will replace a battery which has operated since 1918.

In November, National Steel Corp. started its new No. 9 coke battery at Weirton. This consists of 41 ovens, 13 ft high, 40 ft-6 in. in length, and 17 in. average width. The ovens have a 3-in. taper from the pusher side. Each oven is designed to hold a 17-ton coal charge. The battery is built on the site of the original No. 1 battery which started operation in 1923. Existing batteries No. 4, 5, 6, 7 and 8 plus new No. 9 battery give Weirton Steel a total of 294 ovens capable of producing 5200 tons of furnace coke per day.

Reports on experimentation on the high temperature strength of bulk coke by Battelle Memorial Institute

indicate that strength at elevated temperatures may not be related to strength at room temperatures. Shatter and tumbler tests conducted at room temperatures give a good indication of the breakdown coke will undergo during shipment and handling. The Battelle experiments tumbled coke at temperatures up to 2500 F and showed that the mechanical strength was affected by the high temperatures. Cokes which had similar properties at room temperatures often exhibited widely different high-temperature strengths.

In order to improve coke making practice, Kaiser Steel has added another step in their coal preparation. This is a flotation circuit which should reduce the ash content of the minus 28 mesh coal from about 19 to 6 per cent, which will reduce the total ash content of the coal by about 1 per cent.

A development which may offer the coke industry some competition is the use of gilsonite as a base to form high purity electrolytic coke. A processing plant is under construction, to be completed early in 1957, at a location near Grand Junction, Colorado. Gilsonite is a black solid hydrocarbon with a high-resin content which has been largely used in making asphalt floor tile, storage battery boxes, and as an insulation for hot underground pipes. Most of the deposits of the material are in eastern Utah. It is believed that the material will find a ready market in the manufacture of aluminum and in the specialty carbon field.

One of the problems of waste disposal, that of eliminating the phenols from waste liquids produced by coke oven operations, may be overcome by a new piece of equipment which includes a centrifugal, counter-current, multi-stage solvent extractor. It is claimed that it can eliminate more than 90 per cent of the phenols from the coke oven waste liquors with a caustic consumption of one lb or less per lb of phenol removed.

Jones & Laughlin Steel Corp. announced a $2,000,000 project to install two new processes for the purification of the coal chemicals produced in the by-product plant at their Aliquippa Works. Completion is scheduled early in 1957. One of the processes is for sulphur removal from benzol, toluol and xylol; the other for the final purification and removal of all the remaining non-aromatic impurities.

At present, the chemicals are purified by washing with sulphuric acid which results in a substantial loss and forms sludges which present a disposal problem. In the sulphur removal process, the light oils will be treated with hydrogen at moderate temperatures and pressures, which will convert the sulphur compounds to hydrogen sulphide and hydrocarbon gases. After removal of the hydrogen sulphide and the hydrocarbon gases, the light oil moves to the second process. Here it is contacted with a glycol solvent which has a strong preferential solubility for aromatic hydrocarbons. Aromatic hydrocarbons which are dissolved are withdrawn from the bottom of the extractor and separated from the solvent by distillation. The solvent is then returned to the extractor.

U. S. Steel Corp. awarded a contract to build a light oil purification plant at Clairton which will be one of the first in this country to use another new process for the production of super-refined light oils. The use of the new process eliminates practically all the impurities naturally contained in these oils. This is a pressure catalytic refining process. The present acid sludge disposal problem is eliminated. Construction is scheduled to be completed late in 1957.

STEELMAKING

Except during the strike, emphasis in the steelmaking departments during 1956 was in keeping operations at full capacity. The year was highlighted by several important developments in steelmaking. The oxygen-blown converter for making steel is now an accepted tool of the steelmaker. Several companies announced construction programs for converters, and other companies are considering such units.

There was increased emphasis on high vacuum techniques in steelmaking, both in melting the steel and in pouring the ingots. This operation will become a more important part of the future steel plant. Greater use of basic refractories in open hearth is evident. Finally, more and more oxygen is being used, and it appears that the oxygen plant will become an integral part of the steel plant, whether owned and operated by the steel company or whether installed on some sort of rental or lease basis.

Some very realistic estimates on steel expansion indicate that there will be some 150,000,000 tons of ingot capacity by 1960. This means an addition of some 21,000,000 tons to present capacity. A breakdown indicates that, of this added capacity, 7,000,000 tons will be in the open hearth shops, 7,000,000 tons in oxygen-blown converters and some 7,000,000 tons in electric furnaces.

The advances made in the steelmaking shops over the past few years in the United States are summarized as follows:

1. Improved layout.
2. Use of richer fuels and oxygen.
3. Mechanization.

Smoke such as that shown will be essentially eliminated when the new precipitators authorized for the open hearth furnace at Homestead are installed.

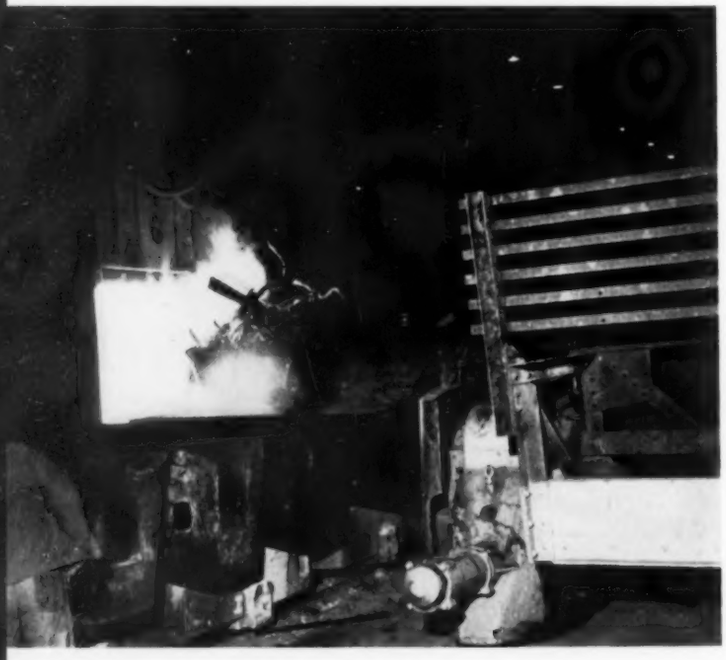
4. Better methods for handling materials and refractories.
5. Faster rebuilding of units.
6. Rapid charging and heating.
7. Automatic controls and instrumentation.
8. Better refractories.
9. Planned maintenance of equipment.

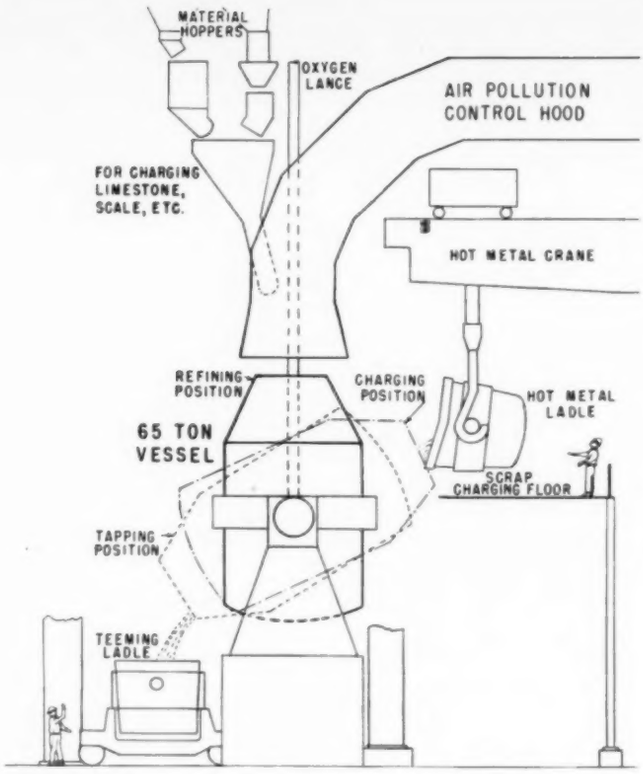
Much of the growth in capacity and efficiency of the steel shop can be attributed to the foregoing items and to the increased availability of furnaces which they have made possible. The national average in the United States is about 91 per cent, and in some of the larger shops the figure goes up to 95 or 96 per cent. In addition, inadequate checker capacity has been eliminated in many shops.

The trend to bigger open hearths is a major factor in the production of steel. At the beginning of 1956, 29 companies had 204 open hearth furnaces which were capable of making more than 225 tons each, compared with only 30 such units in 1947. On the other hand, the number of small furnaces declined. The production rate for each group of furnaces has also been increased, in some cases going up about 10 tons per hr per 1000 sq ft of hearth area to as high as 30 to 35 tons per hr per 1000 sq ft of hearth area for hot metal furnaces. In 1945, when open hearth capacity was over 84,100,000 tons, there were 990 open hearth furnaces. In 1956 there were 911 open hearth furnaces capable of producing 112,300,000 tons. Today's largest unit in operation taps over 550 tons per heat and a 600-ton unit has started recently.

Increasing open hearth steelmaking capacity will necessitate additional scrap preparation facilities in many plants. A typical example of what is required is represented by the work recently done at Armco's plant at Middletown, Ohio. Armco built a scrap preparation yard which has facilities for handling scrap, shearing it, bundling and bailing. A force of 54 men operates the yard, one 8-hr turn, 5 days a week, and some 8300 net tons of scrap are burned, sheared, pressed or sorted for the mill each month.

Large charge boxes (those shown hold 61 cu ft) increase open hearth production by reducing time to charge furnace.





The making of steel in oxygen converters is now an accepted practice.

The eight open hearth furnaces at Alan Wood Steel Co.'s plant at Conshohocken, Pa., have new control systems which in less than a year of operation have paid for themselves in terms of fuel savings. By-product coke oven gas at this plant had been sold to a local utility, who converted to natural gas. Provision had to be made to use the coke-oven gas, and it was decided to use it in the open hearth in combination with either oil or tar. The system automatically uses all the coke-oven gas which is available and adds the amount of liquid base fuel which is necessary to get the required Btu input to the furnace. The system also records all variables and is so set up that manual operation can be used when desired.

In noting progress of the all-basic open hearth furnace, one factor is that good refractories have been developed for all parts. Furnace designs minimize the compressive force on the refractories through the use of suspension, the absence of corbelled surfaces and proper expansion provisions.

Much of the success of the all-basic furnace is due to operating practices which would have disastrous effects on silica furnaces. All-basic furnaces can produce from 10 to 25 per cent more steel than a comparable silica furnace with fuel consumptions from the same to 10 per cent less than silica furnaces. Increased productivity comes from faster melting and from greater availability. Practices which have increased productivity include: (1) increased fuel input; (2) maintenance of high fuel input throughout melting period; (3) adoption of furnace chamber and port designs which promote rapid combustion and high temperature;

(4) improved combustion control; (5) use of oxygen for combustion; (6) increase of air preheat temperature; (7) increase of furnace hearth area and heat size; and (8) increase in use of oxygen for decarburization. Increased availability of the basic open hearth is due to: (1) roof life about three times that of silica; (2) long port end life; (3) regenerators which stay efficient throughout furnace run; (4) small brick requirement for overall construction which reduces construction time; (5) rapid teardown of smaller furnace sections when repairs are necessary; (6) easy slag removal compared with silica furnaces; (7) independent support of various furnace sections so that only completely worn-out parts need to be replaced. In looking to the future, the possibility of six-hour heats with reasonable refractory life does not appear impossible.

The first all-basic flat-roof open hearth at Inland Steel Co., has poured 240 heats with only a single patch by the middle of last year. The patch was necessary at the point where the oxygen lance was used and where hot metal is poured into the furnace. This is the first flat-roof all-basic open hearth which has used hot metal as a part of the charge. A similar unit is being used by Keystone Steel & Wire Co., but it operates on a cold charge. It is estimated that the Inland furnace will produce 390 heats before roof replacement is necessary. Existing arched silica brick roofs in the same shop have an average life of 141 heats.

Keystone is operating four furnaces with three different furnace designs. One design has three uptakes and has the general lines of a box car furnace. With the exception of the main roof and port roofs, the entire furnace is constructed of basic brick or basic veneered walls. Basic brick is also used in semicircular arches to support the front and back walls.

Another type of furnace operated in this plant is known as a "tapered-in" furnace, so called because the front wall, back wall and roof are tapered inward or downward toward the end of the furnace. The ends of this furnace, which has a single uptake, have been converted to basic construction, including the port roofs which are sprung. The main roof of this furnace is conventional silica with ribs.

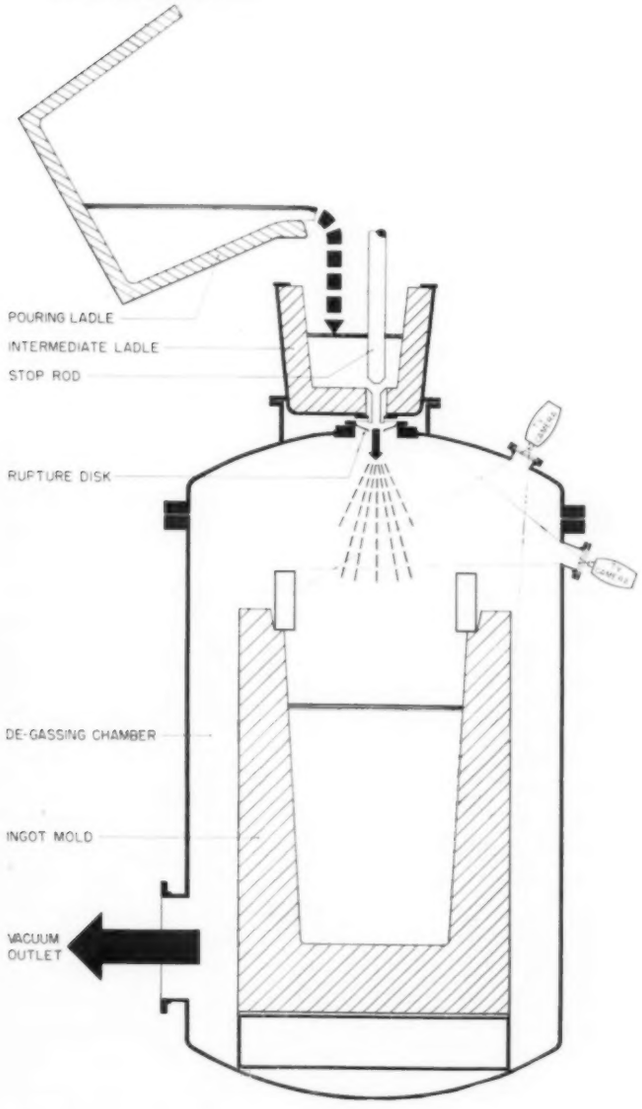
The third type of furnace at this plant is an all-basic single uptake type on which the main roof is flat and completely suspended. This furnace, which was originally installed with a basic end and later converted to an all-basic furnace, now has basic refractories in a portion of the checkers to as much as 50 per cent of the depth in some areas.

A number of all-basic open hearths are in use in Europe. One report on a British furnace states that in three campaigns covering a period of more than four years, 1423 heats, 1107 heats and 2205 heats, respectively, were obtained. General roof construction was of the regular European design with only the ribs being suspended and the valleys sprung. The size of this particular furnace is only 60 tons. In a German plant, with 85-ton capacity furnaces, using both silica and basic roofs, as many as 400 heats are obtained on silica roofs. The best campaign on the all-basic construction is 1490 heats. A Danish open hearth shop reports that three all-basic furnaces of 115-ton capacity have had campaigns of as high as 523 heats. These units also have a typical basic roof construction. The comparatively poor results of this last unit compared with the others are due to the fact that this shop operates with an all-cold charge.

These reports indicate that somewhat better results have been obtained with basic roofs in Europe thus far than in the United States, but the European type of construction and rate of driving may account for some of the difference. Based on the limited experience in the United States and the information which is available from Europe, it now appears that the use of all-basic roofs in open hearths will probably require a more extended use of basic refractories throughout the entire regenerative portion of the furnace, because of the higher firing rates to which these furnaces are subjected. This will be desirable to obtain maximum furnace life and economy.

Some tests in the open hearth at Jones & Laughlin Steel Corp., indicate that trial runs on a new design of open hearth roof increases roof life about 14 per cent. The design consists of a new pattern in which a course of basic brick is alternated with two feet of silica brick. In place of the six courses of magnesite-chrome metal encased keys, which were normally used as a basic

Equipment for vacuum casting of ingots is being installed in several plants to get better steel, particularly for forging applications.



A new ingot vacuum casting chamber was installed at the Duquesne plant of U. S. Steel.

shoulder along the back of the roof, the brick pattern consisted of two courses at back skew, two feet of silica brick, one key course of basic, two more feet of silica and another basic key course. On the front of the roof, the first basic key course was two feet up from the front skew and was followed by two feet of silica brick and a second course of basic key brick. Basic brick was used in the front half of the roof in only one trial. It is believed the beneficial effects are obtained because the brick prevent the saturation of the silica brick which is adjacent to the back wall with the liquids which develop in the silica roof brick refractories, and which migrate or flow to the back wall portion of the open hearth silica roof.

Steel Company of Canada reported on the operation of an open hearth furnace in which oxygen for carbon removal is introduced by means of a water-cooled lance through the roof of the furnace. The lance has been used through two furnace campaigns. The first campaign established a satisfactory pattern for using the oxygen and the second campaign was used to assess its value compared to normal practice. To get a fair comparison, oxygen was used on alternate heats and these compared with the heats when oxygen was not used. Results showed that, apart from oxygen consumption, lower fuel consumption and lower average finish carbon were typical of the oxygen heats. The oxygen heats had a 45-min saving in tap-to-tap time, giving an increase of 2.27 tons per hr.

United States Steel Corp. announced during the year that electrostatic precipitators are to be installed on the 11 furnaces in their No. 5 open hearth shop at Homestead. Even though no perfect solution to open hearth stack emission has been found, the company believes that the electrostatic precipitators give the best approach to collecting dust from open hearths. This shop adapts itself particularly to this kind of an installation, since the waste-heat boilers in the shop will provide a method for cooling the gas for the precipitators. When the project is completed, the shop will have a completely automatic air pollution control system operated from a central control station which will provide push-button control of gas flow and dust removal.

Jones & Laughlin Steel Corp. also authorized an expenditure of $2,000,000 to reduce smoke condition at its Pittsburgh works. The project consists of a number of items, but a major feature is the installation of electrostatic precipitators on the furnaces in the open hearth shop at a cost of about $1,500,000. The unit is an experimental project from the standpoint of determining design limitation. Results will be used as a guide for completing installation.

Kaiser Steel Corp. recently purchased seven additional units which will complete cleanup on all nine open hearths at the Fontana plant. This equipment features an electrical precipitator which has been developed from extensive experimentation. The units are equipped with selenium rectifiers and saturable reactors, and are designed to handle 58,000 cfm at 460 to 470 F. It is believed that selenium rectifiers require less maintenance and replacement parts than other types, and have other advantages which make them ideal for open hearth applications. Performance of the equipment is such that it maintains an outlet loading of less than 0.04 gr per cu ft.

A new practice in rebuilding open hearth furnaces was successfully accomplished by engineers at the Geneva works of U. S. Steel Corp., involving complete assembly and building of all the structural steel framework for a furnace outside the open hearth building. This was then moved into place as a unit. An experimental rebuilding job on one of the nine 12-yr old furnaces at this plant was completed in 15 days, believed to be a record for furnace reconstruction, and a savings of about 15 days over conventional rebuilding.

Granite City Steel Co. expects to increase their ingot production without the addition of another open hearth furnace through the use of the largest charging boxes in the steel industry. Three of their 285-ton furnaces and four 250-ton furnaces have been converted so that they can be charged with the larger boxes. It was necessary to replace the old 4 x 4-ft charging doors on the furnaces with 5 x 5-ft doors, and furnace roofs had to be elevated to permit a greater turning radius. This work was done as campaigns on each furnace were completed.

The new boxes have a capacity of 61 cu ft, nearly double the old boxes. About 30 per cent of the charges to the furnaces are now made with the big boxes. The heaviest scrap is charged in the small boxes. A special peel was used to enable the charging machines to handle both the new and the old boxes.

A new high capacity refractory gun speeds furnace

patching and enables many repairs to be made without shutting down the furnace. The unit can emplace a ton of refractory to the hot inside surfaces of a furnace in a very few minutes, and may be used at any time during the furnace cycle. Fuel need not be shut off or even cut back. In the unit, the water necessary to cement the refractory is introduced under high pressure by a nozzle under control of the operator. When connected to an 80-psi air supply, delivery is in the neighborhood of 400 lb of refractory per minute.

Additional data on the operation of the oxygen-blown converters at McLouth give some interesting details. Initially, the operation at this plant used blast-furnace hot metal and cold pig iron. Since pig iron has some fuel value, a larger portion of cold iron than of cold scrap can be used for a given silicon content. The blowing times when using cold pig iron are about three minutes longer. At the present time, the McLouth converters are being operated on a scrap charge of about 60 per cent heavy mill scrap and 40 per cent light purchased scrap. The use of cold pig iron or steel scrap is dictated by the availability of each and their relative costs. Production has been constantly rising and as many as 32 heats per day have been made. This can be increased as certain crane restrictions are corrected.

The typical blast furnace hot metal averages about four per cent carbon, 0.99 per cent manganese, 0.133 per cent phosphorus, 0.025 per cent sulphur and 1.12 per cent silicon. The flux portion of the charge is set to maintain about a 3 to 1 lime to silica ratio in the final slag. Burned lime, limestone, mill scale and aluminous material or fluorspar are used. Phosphorous runs below 0.015 per cent with the average about 0.012 per cent. Sulphur averages about 0.017 per cent in the final steel and has been no problem. The oxygen plant at McLouth produces 99.5 per cent purity oxygen and as a result the nitrogen content has been low—usually in the range of 0.0015 to 0.0025 per cent. Production has been rimming steel, top poured.

One of the larger oxygen converter plants now under construction is the unit at Aliquippa being built for Jones & Laughlin Steel Corp. This plant will add over 400,000 net tons of annual steel capacity. Construction is scheduled to be completed in the middle of 1957, and this will be the second plant to be completed in the United States. This installation will have two converter vessels which will initially produce 54 tons of steel per heat.

Kaiser Steel also has an oxygen converter plant under construction. When this and J&L's programs are completed, U. S. production of steel by the oxygen converter process will exceed 2,000,000 ingot tons per year.

Another plant which has adopted oxygen converters is the Hindustani plant at Rourkela, India. Here three-quarters of the planned 1,000,000-ton annual production will be made by the oxygen converter process.

Favorable reports have been received during the year of a new Swedish steelmaking process. Among the benefits claimed are increased efficiency, savings in iron, lower cost, and the ability to maintain a constant carbon content. A 30-ton converter has been in regular production since May, 1956, at the Stora Kopperberg in Sweden. The unit uses high phosphorus irons, typical in Sweden. It is believed this process should work just as well and perhaps faster with the low phosphorus grades used in the United States.

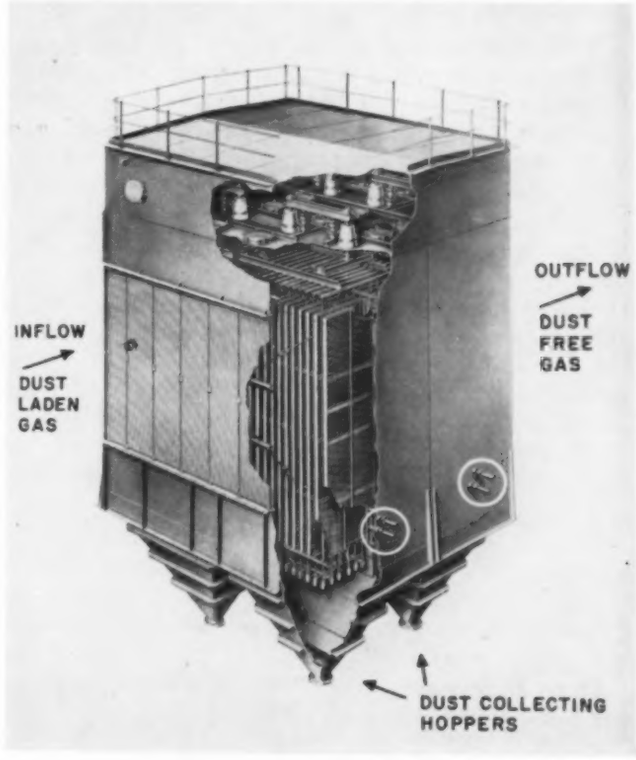
The converter has a blowing cycle of 35 to 40 min and requires two slag-offs to accomplish the phosphorus reduction. It is estimated that with low phosphorus iron, blowing time can be 25 min with a tap-to-tap cycle of about 40 min.

Oxygen is introduced through a central opening in the top of the furnace which has the shape of a conventional bessemer converter. The exhaust gases also escape through this opening. The vessel rotates while at an angle of about 15 to 20 degrees from the horizontal, which stirs the bath and keeps the slag balanced. Because of the large area of contact with oxygen, there is rapid dephosphorization and desulphurization. At the same time, however, the carbon in the bath is said to remain high. It is also claimed that there is a lack of the heavy brown iron smoke which normally accompanies ordinary converters.

Average oxygen consumption is about 2250 cu ft per net ton of steel produced. Iron additions are used to cool the bath. This also saves scrap and boosts iron in the finished steel. The average ore addition is about 14 per cent of the hot metal. Cost studies indicate that the process makes steel about $3 a ton cheaper than in the company's electric furnaces.

Bottom-blowing high-silicon iron with oxygen-enriched air may result in ejecting metal from the converter during the early low temperature stage of the blow. In Europe various methods have been tried to desiliconize hot metal in the iron ladle with low pressure oxygen to produce a superheated iron which can be successfully bottom-blown with oxygen-enriched air at full blast throughout the entire refining period.

Continuous dust collection from precipitator units keeps cleaning system operation at maximum efficiency.



The net result is a reduction in blowing time and lower nitrogen content in the finished steel. At one plant in the Ruhr district, about 80 per cent of all the iron produced is preblown with oxygen before going to the mixers. There are six blowing stations under one roof, each with a water-cooled cast iron hood rigged so that it can be lowered flush against the rim of the iron ladle. Projecting through a hole in the side of the hood is a short, water-cooled, copper-tipped, oxygen lance tilted downward at a 30-degree angle so that the tip is about 6 to 12 in. below the surface of the metal. Oxygen of 73 per cent purity is blown for about 30 min at the low pressure of 2.5 atmospheres. As a result of this treatment, the silicon content is reduced to about 0.25 per cent and the manganese to about 0.60 per cent, with a 100 to 150 F rise in iron temperature.

An interesting development in the desulphurization of iron with solid lime is the Kalling-Domnarvet process, in which molten iron is treated in a rotating cylindrical furnace with finely ground burnt lime. The furnace is rotated at about 30 rpm, and since no molten slag is formed during the process, the furnace can be lined with ordinary fireclay brick. Iron which contains up to 0.100 per cent sulphur can be treated with 1 per cent powdered lime and after 15 to 30 min in the rotating furnace, the sulphur is reduced to 0.010 per cent or less. The cost is said to be about 50¢ a ton for the operation. The largest furnace built so far holds about 30 tons of iron, but a 60-ton furnace is now under construction.

Electric furnace steelmaking capacity is more than holding its own in the race for additional production. In 1956 electric furnace steelmaking capacity was slightly over 11,000,000 tons. A steady influx of orders for new units is gradually increasing the proportion. Of 60,000,000 tons new capacity which are projected between now and 1970, between 20 and 30 per cent is expected to be electric furnace capacity. More immediate forecasts estimate that the increases will run from 1,000,000 to 2,000,000 tons per year.

With present scrap prices, however, unless a method is developed to use hot metal economically, electric furnace expansion will not grow as fast as it might otherwise. One steel company has been working on increasing the hot metal charge in their arc furnaces to the point where today they can regularly use a 50 per cent charge of hot blast furnace metal. They find there is a reduction of about six per cent of the power used and an increase of ten per cent in hourly output. One of the arguments against the hot charge is the violence of the boil. This company changed some of its procedures, developed a practice where violent boils are not present, and the operation runs quite smoothly. The work is being done in electric furnaces which are perhaps smaller than the average, but it is believed that with larger furnaces, larger percentages of hot metal could be used.

Among the units being built, Republic Steel is replacing three 70-ton furnaces with 130-ton units in the Chicago district. In addition, Republic is installing four new 170-ton furnaces, two in Gadsden, Alabama, and two in Warren, Ohio.

Jones & Laughlin Steel Corp. are entering the electric furnace field with two 125-ton units at the Cleveland plant.

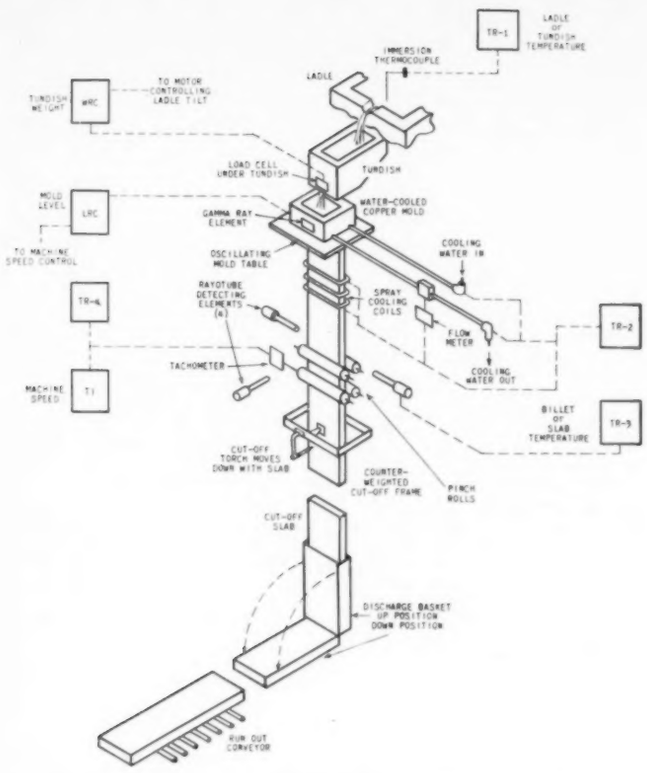
Successful solution of methods for smelting pig iron electrically may accelerate electric furnace installations. These methods are well established in some European countries for relatively small production units where electric power is available at a very reasonable cost, and where coke is expensive. In such furnaces, the carbon monoxide gas which is produced has heat values which, if used in heating the charge, will reduce power requirements. In one pilot plant, a rotating kiln is used in which the charge continuously travels against a counter-current flow of hot gases. This preheats the charge up to about 900 F. Results of these tests indicate that, for a given amount of power, it is possible to increase metal production from 30 to 50 per cent. Power consumptions as low as 1400 kwhr per ton of pig iron were attained.

An interesting proposal by Copperweld Steel Co. at Warren, Ohio, involves direct electric melting of iron ore pellets. This is a result of research at Battelle Memorial Institute on the Euby-Lorig process, in which natural gas is cracked into hydrogen and carbon black, and the hydrogen used as a reducing agent. Estimates are that 10,000 cu ft of natural gas will be needed per ton of pellets. A somewhat similar direct reduction process is used in Switzerland.

Jones & Laughlin Steel Corp. will furnish a complete dust-control system for their new electric furnaces in Cleveland. The application of electric precipitators is relatively new for such units, and the design of this plant is patterned after experience gained on a similar unit on the West Coast. The dust and fume control system will be comprised of the following parts: (1) flame traps, to cool the gases leaving the furnaces; (2) flues, to conduct gases from the flame trap to the collection equipment and stack; (3) humidification towers, to add required moisture needed for treatment in the precipitator; (4) electrostatic precipitator; (5) draft fans; (6) a stack to exhaust the clean gases; and (7) instrumentation to maintain proper draft and spray conditioning.

Two general approaches are being made to vacuum melting. One, consumable electrode melting, consists essentially of an arc furnace in which the metal is fed into the melt in the form of a bar. The bar acts as an electrode and the high temperature arc struck between the bar and the crucible gives the heat which melts the metal which in turn drops into the crucible. The second method is induction melting, in which the metal is placed in the crucible and high current is fed through a water-cooled copper coil surrounding the crucible. Both methods have advantages and limitations. It has been estimated that the arc method will turn out larger ingots than an induction furnace for a given investment in equipment. The induction furnace cannot handle highly reactive metal such as titanium. On the other hand, the induction furnace gives the operator better control of the melt temperature.

Allegheny Ludlum Steel Corp. completed a two-unit expansion program for consumable electrode vacuum remelting of high temperature superalloys at its Watervliet plant in May. The company then started a further program which will double the capacity of the plant. This was scheduled for completion before the end of 1956 when melting capacity should be 1,500,000 lb per month. Allegheny Ludlum also



Instrumentation is an important factor in keeping a continuous casting operation going at maximum efficiency.

sold patent rights for the consumable electrode vacuum melting process to the Midvale-Heppenstall Co. who immediately started to install production facilities to use the process.

Allegheny Ludlum is also working with a new induction unit at Watervliet which will turn out heats one after the other at about 4-hour intervals and which is engineered for 24-hour continuous operation. The first installation is now in pilot operation, and has been turning out 300-lb heats for some time. The pilot unit is scheduled to move directly to the production line where capacity can be increased to 2000 lb by providing a large crucible which the original design called for.

Universal Cyclops constructed a production pilot plant for vacuum remelting with a capacity of about 750,000 lb of ingots a month. The pilot plant will melt ingots up to 20 in. in diam weighing about 6000 lb. By remelting under a vacuum, non-metallic inclusions are removed and excess gases are eliminated.

An interesting item on the development of vacuum melting is the use of the mass spectrometer to aid in the control of the process. A record of the gases which are drawn off during the initial pump-down, melting, and in the later reducing stage tells when these processes have reached their endpoints. Knowledge of this enables the melter to stop the operation.

Care must be taken to distinguish between the process of vacuum melting and vacuum degassing. In vacuum melting, the metal is degassed during the melting cycle and the process allows additions to the melt during the cycle. In vacuum degassing, the trapped gases are removed from the liquid metal after the melting cycle.

United States Steel Corp. started vacuum casting of large forging ingots at their Duquesne works. The new equipment consists of a steel chamber made up of three sections, a base, a top and a cylinder 31 ft high and 17 ft in diam. The cylinder is supported by heavy steel members which allow the chamber to shift or move about during pouring operations. Heavy rubber rings seal the sections, making the chamber airtight in order to maintain vacuum during casting. After a vacuum has been created, the hot metal is transported to a basket ladle located on the top of the vacuum chamber. The heat of the molten steel melts an aluminum diaphragm and molten metal breaks up into many droplets before entering the ingot mold placed inside the chamber. The flow of metal is controlled as it enters the chamber at a rate of three to ten tons a min. Harmful gases are removed from the steel as it is being poured. After the ingot has been poured, the vacuum in the chamber is broken and the steel is allowed to cool.

A 10-ton degassing unit was also installed in a large eastern steel plant and a 250-ton unit is being built. Equipment consists of a pouring ladle, an intermediate ladle and the degassing chamber into which the ingot mold is placed. Before pouring begins, the antechamber between the bottom of the intermediate ladle and the top of the vacuum chamber and the vacuum chamber itself are evacuated. The stopper rod of the pony ladle is lifted, the molten metal burns through an aluminum diaphragm, and the instantaneous pressure drop causes the stream to diffuse into a fine spray. Pumping system consists of a group of steam injectors which work continuously during the pour. The vacuum is broken as soon as the pour is completed. The walls of the vacuum chamber are water-cooled, and TV cameras control the process.

Abrasive shot blasting has been found effective in conditioning ingot molds on a production basis. At one plant, mold interiors are blasted with large size steel shot every fourth or fifth cast. This keeps the surfaces clean and also closes fire cracks by peening action. Ordinary mold sizes take about 10 min.

A new hot top is composed of highly insulating and combustible material, normally manufactured in four cakes which fit closely to the mold wall. The steel ignites these cakes which burn during the entire solidification cycle, giving off enough heat to keep the steel liquid in the hot top. When the ingot is solidified, the relatively small hot-top butt, surrounded by a frame of ashes, contains whatever segregation has taken place. The combustible material does not contain any material detrimental to the steel, and does not deplete alloying materials. It is claimed that improvements in yield as high as 10 per cent after rolling have been obtained.

Another method of hot topping has been giving excellent results at a steel plant in the Pittsburgh district. Claims made for the method are a hot top metal loss of only four per cent of the total ingot weight, less segregation, less splintering, and improvements of three to ten per cent in yield. This method uses an exothermic material consisting basically of aluminum chips or powder, and a combination of chemical compounds which can release free oxygen to ignite the aluminum and give off heat. The temperature of this

lining when pouring is about 3600 F. The material is purchased already rammed into clay hottops. It is smokeless, and will not ignite until hot metal is near it, since it ignites at temperatures above 800 F.

It is estimated there are now some 20 plants, either in operation or under construction, in the country which use continuous casting for various types of metal.

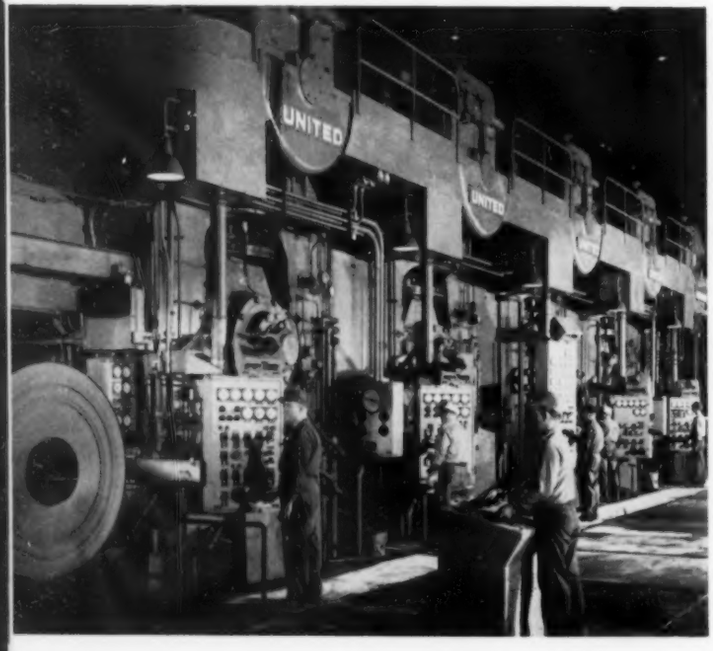
In the non-ferrous field, one company is considering incorporating vacuum pouring in the continuous casting process. This will be accompanied by a shift from vertical to horizontal casting equipment. The proposed casting machine consists of an air-tight spout which will carry molten metal to the tundish and then to an oscillating water-cooled copper mold about 3 ft long. A small vacuum pump maintains vacuum in the mold. Features of the equipment are the sealed spout which leads to the tundish and thus eliminates need for an inert gas atmosphere around the tundish opening, and the use of water sprays to seal the exit end of the mold. The water turns to steam at the point of contact and provides a back pressure.

It is reported that mild steel billets of commercial quality are being produced in a pilot continuous casting plant in Great Britain at speeds over 200 in. per min. Production runs 7 tons of 2-in. sq steel billets per hr. This plant uses the Rossi-Junghans' process, is capable of producing billets from 2 to 4 in. square, and slabs of up to 6 x 2 in. The unit has been used successfully for mild steels, low alloy steels and stainless steel.

Improvements in continuous casting at Atlas are credited partially to better control equipment. Some of the variables which must be governed in the process are the molten and solid metal temperatures, the levels of the molten metal in the tundish and mold, the machine speed, and the temperature and flow of cooling water. Inasmuch as operating conditions must vary in the production of the various grades of steel made at Atlas, automatic recorders were applied to the continuous casting equipment. By using charts from previous successful runs, the operators can duplicate conditions which are needed for successful reproduction. The instruments perform many functions, including such items as control of ladle tilt by weighing the metal in the tundish, and regulation of machine speed to maintain a constant metal level in the tundish. One of the units is an automatic gamma-ray instrument connected to a recording controller so it can regulate machine speeds. The unit speeds up the machine as the level of the molten steel rises and slows it down as the level falls.

An interesting unit for continuous casting of aluminum has an oil-lubricated graphite mold which can handle all types of aluminum alloys in a number of shapes and sizes. The aluminum goes from a tundish into a graphite mold directly under it. The graphite mold is encased in a copper outside mold on which water is sprayed for cooling. In the upper part of the graphite mold is a series of vertical grooves which are kept filled with oil. The porosity of the graphite allows the oil to penetrate into the inner surface of the mold where it lubricates the casting moving through the mold. The process will make a smooth rod at a rapid rate. Plans are under way for building a machine which can handle rods of extrusion billet size, 8 in. or larger.

New tandem cold mill at Weirton is among the fastest in the world.



ROLLING

Perhaps the outstanding trend in the rolling mill field is the application of computer or card-programming techniques to rolling mill operation. These applications indicated for the first time that the day of the automatic rolling mill is not too far off. A number of applications are under way. Included in these are such variations as IBM punched cards, pre-set panels, automatic controls based on measurement devices which in turn control drive motors or establish screw settings, etc. Other devices are used for measurements and weighing. Some of these also make adjustments which minimize scrap losses or set sizes to give a maximum quantity of salable product. Computers are used to help set rolling mill schedules to minimize waste in the rolling operation, when short pours or excessive crop of the ingot occurs. The computer will tell the best length to cut each billet after an ingot is cropped.

The new reversing roughing mill at Jones & Laughlin Steel's Aliquippa Works is probably the first completely automatic card program rolling mill. The control system will permit the operator to initiate a detailed rolling schedule by merely pressing a button. A prepunched card is selected for each schedule, and it is possible to follow a definite set of reductions while allowing for variations in temperature and composition among individual slabs. This control system can be defined as a programmed digital automatic control system drive.

On this particular mill, the drives include two 3000-hp motors for the main horizontal rolls, a 375-hp, AISE 622 mill motor for the attached edger, two 75-hp mill motors for horizontal mill screwdown, and two 50-hp mill motors for adjustment of edger rolls. Cards can be prepared in advance for practically every slab and strip size and grade of steel, so that the drafts and speeds will produce a uniform product at a high production rate. Data on the card include such

requirements as mill screwdown opening, edger adjustment opening, mill speed and edger speed. In operation a stack of punched cards is placed in the IBM card reader. The card which applies to the first schedule is read and all information transferred to a transistor memory storage element. The mill is then ready to roll the entering slab. Automatic operation takes place when the first pass is initiated by the operator pressing the pass-advance button. As the slab approaches, the control equipment acts through a magnetic amplifier output unit to preset roll openings and speeds. After one pass, reversing is brought about by sensing devices that read the position of the slab and reverse the rolls after a brief period of slowdown. After all but the final pass, roll openings and mill speeds are readjusted in accordance with the schedule filed in the memory storage element. When the final pass is completed, an indicator light automatically signals the operator at the crop shear that the strip is ready to enter the finishing mill.

On the card, mill screwdown openings can be set from 0 to 14 in. in $\frac{1}{32}$-in. increments, edger adjustment openings from 6 to 44 in. in $\frac{1}{16}$-in. increments, mill speeds can be set at 115, 300, 440, 750, 880 or 1100 fpm. Edger speed is matched to mill speed but is somewhat slower to take care of draft in the horizontal mill.

To make the operation completely automatic, a detector that responds to strip radiation is located on each side of the mill. Each of these detectors is about 8 ft from the mill stand and initiates the slowdown when the tail end of the strip approaches the mill. A strain gage in the mill housing detects the instant the strip leaves the mill for fast repositioning of the rolls. This strain gage is better able to detect the end of a pass than an operator, since the edging rolls obstruct the operator's view of the horizontal rolls.

This 44-in., semi-continuous hot strip mill at Aliquippa is arranged to roll steel directly from the slabbing mill or from reheating furnaces. New mechanical equipment includes a new shear installed in the slabbing mill department, alteration to the bar and billet mill transfer and tables, universal reversing roughing stand, a rotary crop shear, scalebreaking stand, vertical edging mills, six hot strip finishing stands, downcoilers with transfers, pilers, unpilers and conveying tables. The new mill is designed to roll steel up to 38 in. wide which will be delivered to the five-stand tandem mill for cold rolling into tin plate stock. The mill will also roll hot strip for electric-weld pipe, skelp for continuous butt welded pipe and barrel stock.

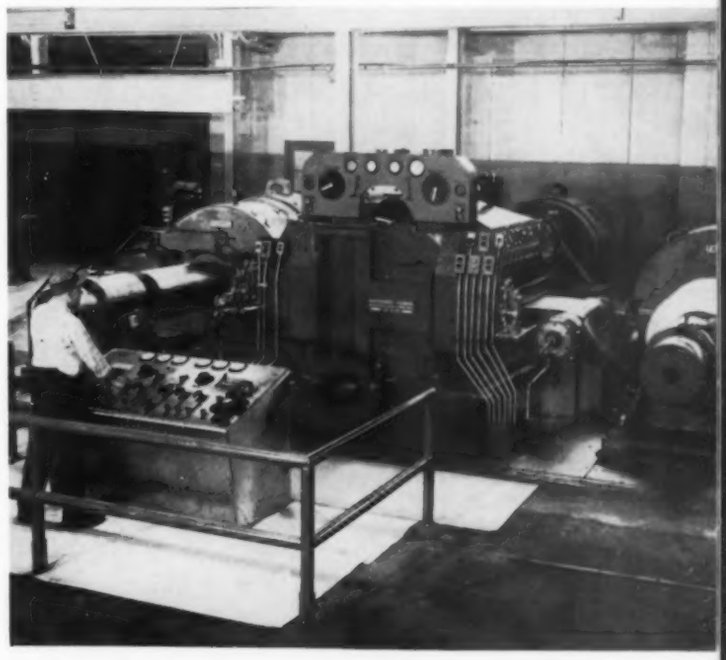
Kaiser Aluminum and Chemical Co. are installing a card program control on one of their heavy mills at Ravenswood. A similar system is also being installed on a mill at J&L's Cleveland works. Another unit is under development for the Chicago district.

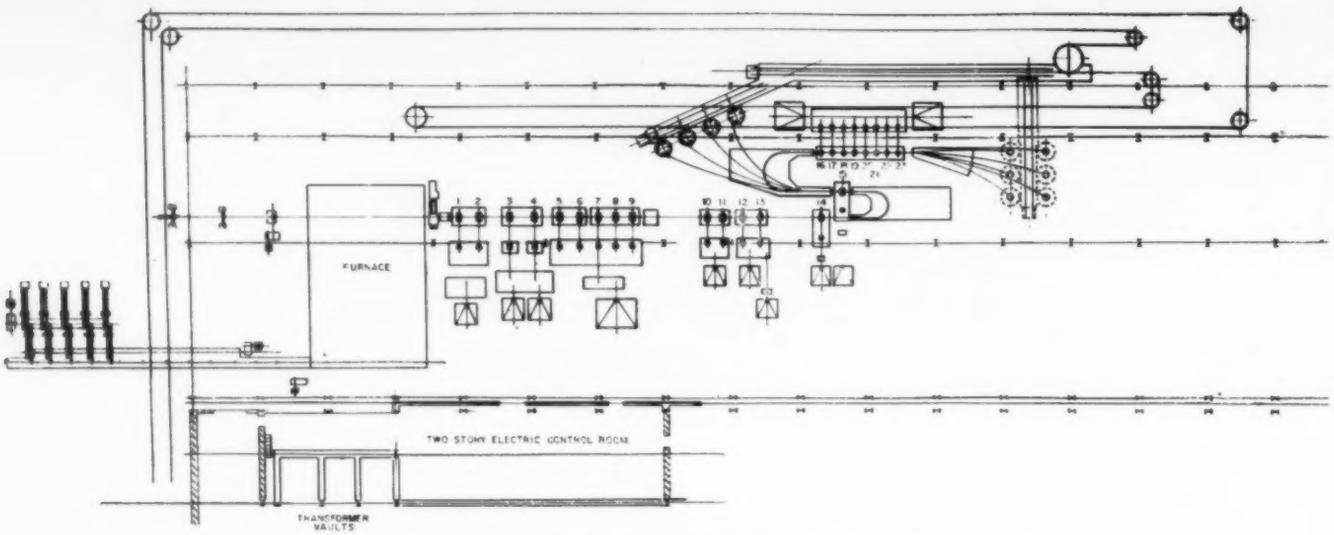
Preset screwdown control was installed on Granite City Steel's reversing rougher for their hot strip mill. The position control gives integrated automatic control of the horizontal rolls, the vertical edger rolls, and the front and back side guides. An additional signal is supplied from the positioning equipment which sets the edger roll drive speed in conformance with the draft on the odd passes. A rolling schedule of up to 15 passes is set up on one of the two slider-type schedule panels. The horizontal roll positions may be set in increments of 0.025 in. over a range of 0 to 9.975 in. The vertical edger roll separation may be set in increments of $\frac{1}{8}$ in. over a range of 22 to 93$\frac{7}{8}$ in. While rolling on one schedule, another schedule may be set up on the other panel. Changing from one schedule to the other is accomplished by a transfer switch.

Isotope gage control systems are being applied to an ever-increasing number of types of equipment. One of the interesting units now in operation is a single sheet, high-speed sorting system which continually checks the thickness of single sheets moving at a very high rate of speed, and provides a signal for out-of-tolerance material at the Columbia-Geneva plant in Pittsburg, Calif. Another unit is located on Ford Motor Co.'s tandem cold reduction mill. Units are also located on continuous hot dip galvanizing lines for measuring coating thicknesses. Other units are used on either side of several Sendzimir mills, tied in with a controller to regulate the position of the work rolls to give close finishing tolerance. On tandem cold mills, it is claimed that gages tied in with automatic strip thickness control can maintain production within plus and minus 0.0001 in. On cold reversing mills, such equipment has doubled the amount of strip which is held to within plus and minus 1 per cent and has reduced strip thickness variations by 50 per cent.

Machinery ordered to increase output of the 86-in. hot strip mill at Kaiser includes slab furnace charging and delivery equipment, a scalebreaking stand, spreading mill for broadside rolling, slab squeezer, vertical edging mills and four universal roughing mill stands. Auxiliary equipment includes conveying tables, roll changing equipment, hydraulic roll balancing equipment and lubricating systems. A contract was also placed for a two-high, 45 x 90 in., universal reversing slabbing mill at this plant. This will have a 10,000-hp, twin-motor drive consisting of two 5000-hp, d-c, reversing motors operating at 40 to 80 rpm. The order also includes a 4000-hp motor for the edger rolls in

New strip mill at Washington Steel can roll material up to 48 in. maximum width.





General plan of new rod mill at Bethlehem Steel Co.'s Johnstown plant.

the slabbing mill. Kaiser will also install new temper mills and an electrolytic tinning line.

Test reports emphasize that hot strip mill temperatures have a marked effect on the characteristics of the product. It has shown that, in all cases, a finishing temperature above the upper transition temperature is very important in obtaining uniformity of grain size, carbide characteristics or mechanical properties. Coiling temperature also plays an important role in determining these items.

In another extensive series of investigations on a 56-in. hot strip mill, particular attention was paid to water practice. This study showed that while temperature drop between the mill and the coiler depends on the time of contact between water and strip, pressure of water and gage of strip, most of the cooling was achieved by time of contact between water and strip. Pressure and flow were of secondary importance. Most of the cooling seemed to be accomplished by the top sprays. The bottom sprays have a smaller effect on temperature drop.

A new 54-in. tandem cold mill went into operation last spring at Weirton. This mill is designed to roll steel strip at speeds up to about 80 mphr and will cold reduce strip steel up to 48 in. wide and 0.090 in. thick, down to a thinness of 0.007 in. Up to 60,000-lb coils are used. It takes 28,000 hp to drive the five stands and the winding reel. The two motors on No. 5 stand total 7000 hp. Features of the mill are a high speed of response, rotating regulator power amplifiers and magnetic preamplifiers.

A 48-in., 5-stand tandem, four-high cold mill was ordered for the Sparrows Point plant of Bethlehem Steel. This mill is designed for cold reducing hot rolled and pickled steel strip to a maximum width of 44 in. Thicknesses will range from 0.065 to 0.125 in. which will be reduced to tin plate gages. Maximum speed will be about 6000 fpm with an average operating speed of about 4800 fpm depending on the product being rolled. Total horsepower on this mill will be 21,150. The equipment will include an entry conveyor, delivery conveyor and coil handling equipment suitable for coils about 73 in. in diam, and weighing about 1000 lb per in. of width.

A new 52-in. Sendzimir mill which went into operation last summer is rolling stainless steel in widths up to 48 in. at Washington Steel Corp. The mill will produce sheet strip with a thickness tolerance of plus or minus 3 per cent, in thicknesses down to 0.005 in. or below. Estimated monthly capacity of the mill is about 3500 tons.

The Aluminum Company of America announced early in the year a third mill expansion program which will add three additional 72-in. wide foil mills at the company's Alcoa, Tenn., works.

For several years, the British Iron & Steel Research Association has carried on exhaustive research work on gage control. It has developed a method using load meters based on the principle that gage variation from a cold reduction mill at constant speed occurs because of changes in thickness and hardness on the entering strip and the tension applied to it. As these changes occur, the roll gap can be held constant by measuring the roll force and using this information to control screw movements. A 3-stand mill at the Port Talbot plant of the Steel Company of Wales is to be equipped with load meters which will automatically control screwdown, and a radiation gage will be provided for monitoring any error which may result from roll wear or temperature effect. The radiation gage can also be used as the intelligence for directly controlling the screwdown.

The use of cast steel work rolls in hot strip finishing stands is increasing. A survey made during the year on 30 hot strip mills showed that 11 used steel rolls in the first and second finishing stands, ten have tried steel rolls and found no advantage, three have trials in progress and six have not tried the rolls. A breakdown of the type of mills which are using them indicates that, in general, conventional continuous mills have found cast steel work rolls to be advantageous and the semi-continuous mills, not. The big difference between the two groups from an operating standpoint is probably the speed at which the steel is fed to the finishing trains. In the conventional mill, steel is usually fed to the finishers almost end to end, and there is little time for the finishing rolls to cool off between slabs. In the other type of mill, since there is a waiting period be-

fore the hot slab comes from the rougher, the first finishing rolls probably get a chance to cool. Therefore, accumulated heat seems to be one of the basic factors in dictating the use of steel over iron work rolls in the finishing stands of a hot strip mill.

In another report on strip mill operation, several recommendations were made on reducing banding troubles. One suggestion emphasizes the necessity of removing all scale from the strip by every manner possible, before the steel enters the finishing stands. Rolls should be made of material which gives the best combination of freedom from graphite with high hardness. The work rolls should also be kept as cool as possible, with plenty of water applied under pressure.

It is reported that ductile iron table rollers at Inland Steel which were installed more than three years ago have given more than six times the service life of ordinary cast iron rolls, and at the time of the report, were still in perfect condition. Cast iron rolls had to be replaced every six months as a result of cracking caused by variation in temperature.

Further word has been received on methods which the Russians are reported to be using in rolling cast iron into sheets from the molten state. One plant apparently can roll cast iron into strips about 42 in. in width. Production costs of the cast iron sheet are reported to be about one-half the production cost of steel. Much of the sheet is said to go into roofing. The composition of iron used is said to be 3.4 to 3.7 per cent carbon, 2.3 to 2.5 per cent silicon, 0.3 to 0.7 per cent manganese, 0.2 per cent phosphorus maximum and 0.12 per cent sulphur maximum.

Another Russian development, short-cutting some conventional steel processing operations, is the hot rolling of gears on a production mill. The finished products are produced faster and cheaper than conventional milled gears. Spur gears, for example, are made by hot rolling teeth in long billets and slicing off the gears as a series of discs. Other gear forms are made by rotating single blanks at predetermined speeds with radially-fed rolls.

A closed circuit television has helped the operators of the Great Lakes Steel Corp.'s No. 3 slabbing mill to obtain maximum cut lengths when shearing hot slabs. The system consists of a self-contained TV camera and one receiver camera is mounted about 20 ft above the mill floor, about 150 ft from a calibrated scale on the slab line. The camera focuses on the scale and transmits the image to the receiver which is installed in the shearman's control booth. As the slab comes up to the shear, he looks at the scale and it is easy for him to make an accurate cut.

The British Iron & Steel Research Association has made many studies on rolling mill operations. One of their new developments is a method for converting molten steel from the furnace into hot rolled strip without some of the conventional intermediate operations. In the new process, cold steel strip passes through a bath of molten steel and increases in thickness as the metal solidifies. The hot strip is then rolled to its original thickness, and a length of strip equal to the original length is returned to the bath for further cycle of operations. The remainder of the strip is then ready for further processing.

It is reported that at least one blooming mill in Russia has been made practically automatic. Photoelectric relays placed at the entry and exit of the mill are used as metal position indicators. Each new ingot is fed automatically by the roll tables to the blooming mill rollers. The feed is synchronized with the operation of the mill in such a way that the ingot reaches the rolls at the exact instant when the first pass can be started. The main driving motor and the table motors are switched on by photoelectric relays which record the position of the ingot and signal the number of passes completed.

The most complicated problem which was raised by the automation of the main drive is the automatic control of the speed at which the steel leaves the rolls. If this speed is too high, the steel will travel too far from the mill so that its return time and therefore the interval between passes is longer. If, on the other hand, it is ejected slowly, it will return before the screwdown has time to move the mill rolls to their next position. An excessive reduction in ejection speed will reduce the average speed of rolling. The optimum ejection speed is determined by an electronic computer which measures the length of the bloom still to be rolled and automatically calculates the travel of the rolls as they run down after braking. The result of this calculation determines the moment when the order shall be sent to reverse the main drive motor. Selection of the right moment for reversing the main drive motors insures that the rolls are running at the proper speed to bite on the steel and avoid slipping. If slipping does occur, the main drive motor is automatically slowed down. Thus when the computer is correctly set, the time between passes (if there is no manipulation) is determined only by the time of operation of the screwdown gear.

The screwdown drive of this mill is also automatic with a non-linear follower system and computer device, which calculates the travel of the mechanisms when the brakes are applied. Settings for changing the screwdown are automatically determined by a multiple-contact step-by-step computer relay.

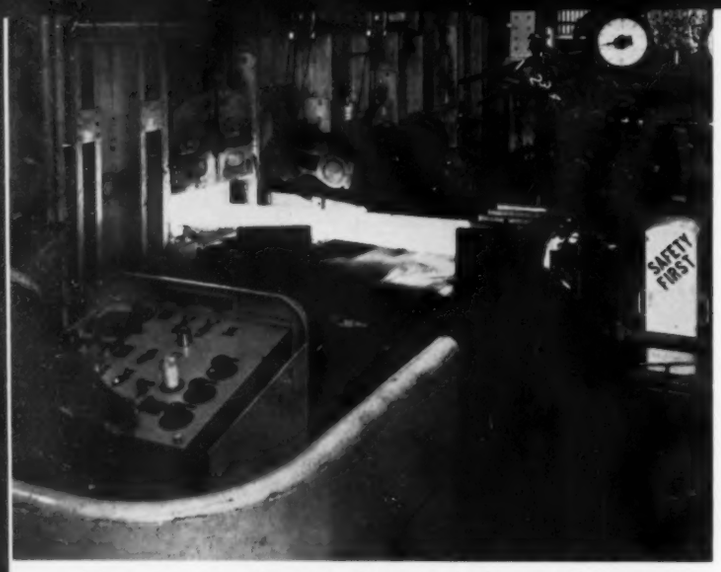
Some benefits reported from the automation are a production increase of 10 to 15 per cent and elimination of as many as 12 men from the mill.

Republic Steel placed an order for a 45 x 90-in., two-high universal slabbing mill for its Corrigan-McKinney Works at Cleveland, Ohio. The order includes necessary auxiliary equipment for ingot handling and for shearing and piling finished slabs. This mill will be powered by two 6000-hp electric motors, and will have an edging roll driven by one 4000-hp motor. It will handle ingots up to 47,000 lb.

After investigating the possibilities of continuous casting of slabs, Inland Steel placed an order for a new universal slabbing mill. It was reported, however, that the casting tests were encouraging, but there was not enough time to master all the problems of the process in time to meet the company's schedule.

The Steel Company of Canada, Ltd., ordered a 46 x 100-in., two-high slabbing mill plus necessary auxiliary equipment for handling ingots. This unit will be powered by two 5000-hp electric motors and will handle ingots up to 60,000 lb, producing slabs up to 72 in. wide.

Sharon Steel placed an order for a 44 x 104-in. two-high blooming and slabbing mill during the year.



The new rod mill at the Cleveland plant of the American Steel & Wire starts with 34 ft long, 3¼ in. sq billets.

Ease of maintenance was the goal in the design of a new slabbing mill which Bethlehem will put into operation in the spring of 1957. This mill will be driven by a 12,000-hp twin drive and a 4000-hp edger motor. Featured are quickly removable air shields on the motors and a twin-drive arrangement with the upper motor located nearer the mill, contrary to typical construction. This arrangement makes both of the motors and the thrust bearings equally accessible for maintenance and repair. A complete ventilating system is integrated into the design of the rotating equipment. Flange couplings are forged which should reduce failures. A number of items of maintenance equipment are actually built into the mill which should reduce downtime when trouble does occur.

Bethlehem Steel Co. placed a contract during the year for a 160-in. reversing plate mill for their Sparrows Point plant. This job will include two new automatically controlled reheating furnaces with charging and delivery equipment, a 38 and 59 x 160-in., four-high reversing plate mill, a vertical edging mill, leveller, shears, trimmers, cooling beds, scales, tables, transfers and plate handling cranes. An existing three-high mill will be arranged to serve as a roughing stand for the new unit.

Recent research on the resistance of plate to brittle fracture indicates that dropping the finishing temperature also drops ductility transition temperature. Hot rolling at temperatures lower than normal on the plate mill to get better toughness is being done at the Royal Netherlands Blast Furnace & Steel Works, Ltd. Here they have a two-high stand for roughing, followed by a long roller table and a four-high finishing stand. Thus, they can allow plates to cool before finishing with little or no loss in production. This practice cannot be used without extensive rebuilding on most American plate mill layouts.

Items in short supply are structural shapes and plates, and much of the expansion in rolling mill capacity is directed to this field. Consideration is also being given to increasing the quality of materials from these mills. The heat-treating of plate is receiving greater consideration by many producers. In addition, quality is being improved in many other but less spectacular ways. In plate materials, efforts are being made to improve such items as notch toughness through better control of steel chemistry and mill practice. One of the factors is a restricted chemistry, a preferred slab size and a definite ratio of aluminum to sulphur in the fully killed steel.

Inland Steel Co. has put into operation a semi-automatic mill for wide flange beams. Automatic controls on this mill can be preset to adjust the position of the rolls. The installation includes a 44-in. universal beam mill, and a 34-in. edging mill, operated in tandem by one operator. They are driven by a 6000-hp electric motor. Following this equipment is a 40-in. finishing mill, a 66-in. hot saw, a 66-in. cold saw, gag press and roller straightener. The control center is an electrical control board on which plugs are inserted for automatic presetting of the rolls. The operator moves the plugs according to the size of the wide-flange beams to be rolled. Both the horizontal and vertical rolls in the 44-in. mill, as well as the edging rolls in the 34-in. edging mill, are automatically reset to predetermined drafts for each pass. A variety of products are possible because of the use of interchangeable roll housings which can be made up in advance of rolling schedules.

U. S. Steel Corp. awarded a contract for structural steel mill equipment for its South Works in Chicago. New equipment includes automatic transfer and turnover devices, hot bed and transfer equipment, straighteners and appurtenances, cold saw, shears and gages.

Pittsburgh Steel Co. announced it will install a $6,000,000 billet mill at its Monessen plant. Construction was scheduled to start in December, 1956, and full operation is scheduled by the end of 1957. The new mill, which replaces steam-driven equipment, will be a 6-stand, 30-in. continuous mill, with three vertical and three horizontal mill stands in line. It will be able to roll blooms from 9 x 10 in. down to 4-in. squares and 3⅝-in. rounds. Main drives include six 1750-hp motors. Downtime for changing roll sizes, which is now as much as 1 hr-15 min will be reduced to as little as two min.

One mill builder has developed a design to reduce the number of stands which may be required in merchant mills rolling a wide variety of products. The design permits a two-high roll stand to be used, in the same location, either as a horizontal or as a vertical stand. The roll stand is driven by the mill motor in the conventional manner from the side to operate as a horizontal stand, or through a bevel gear drive from above or below to work as a vertical stand. These stands can be applied to continuous mills for either single-strand or multi-strand rolling of bars.

A new, high speed, 3-strand rod mill at Bethlehem Steel Co.'s Johnstown plant has a number of features which are now being incorporated in other new rod mills to obtain heavier coil weights, better control of section, freedom from surface defects such as roll scale and decarburization, and more uniform mechanical and metallurgical properties. The mill, in operation since December, 1955, is a compromise between a continuous and a looping mill. A continuous 9-stand roughing mill is followed by a 6-stand intermediate train ending in two repeater stands which feed into an 8-stand finishing train. Rods from 7/16 to ¾ in. are coiled directly after the second repeater. Smaller rod goes from the second repeater through two to eight

finishing stands depending on the rod size.

One of the interesting features of the mill is that forced air is used to cool coils as opposed to water cooling used on some mills. Each of the laying reels at Johnstown are fully enclosed and provided with a separate fan which circulates about 7500 cfm of air on the 600-lb coil. The draft is continued for a predetermined interval after all rings are laid. The four pouring reels are also enclosed, and during the coiling operation, 12,500 cfm of air are blown into each reel. It is stated that this drives the temperature of the coils as much as 300 F below what would be obtained with water cooling in the same period, and also prevents excessive secondary scaling.

American Steel & Wire Div. put into operation a new rod mill at their Cleveland works. This mill will have an annual capacity of about 450,000 tons and will replace two rod mills in operation since 1916. The new facility consists of a combination rod mill, billet storage area and rod storage area. The mill has 25 roll stands and can roll all sizes of rods from a minimum of commercial No. 5 gage up to 1½ in. diam. Sizes up through 9/16 in. are rolled four-strand, while sizes over that figure are rolled either double or single-strand up through the maximum of 1½ in. All rod sizes are rolled from a standard 1200-lb billet, 3¼ in. x 3¼ in. x 34 ft. The heating furnace serving the mill is capable of heating 100 tons of billets per hour.

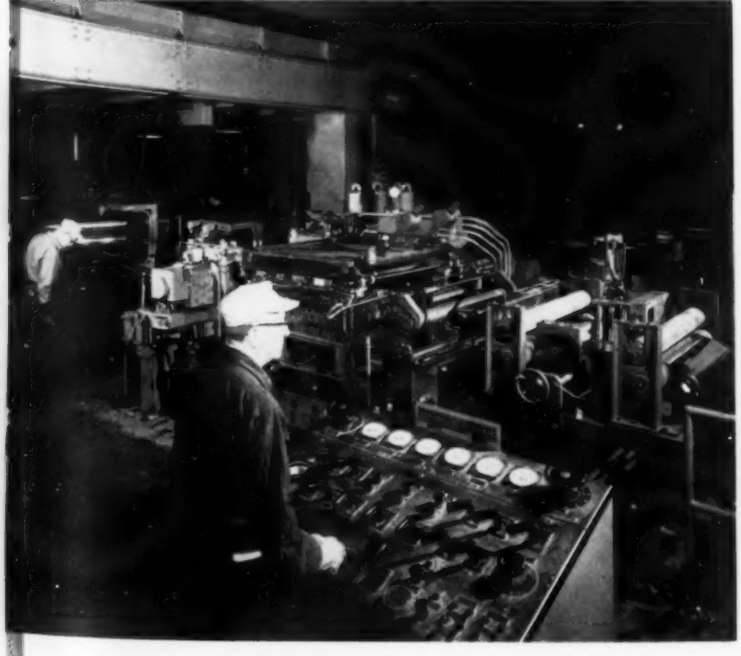
An interesting feature of the mill is a four-line billet switch which is capable of keeping all the active pass lines continuously supplied with hot steel without intervals of inactivity. This entire mechanism is operated hydraulically and controlled by an operator at a nearby control desk, who can see the operations at all times. He also signals the push-out operator when another billet is required. For rolling sizes ⅜ in. and under, there are 23 stands in tandem, starting with five 18-in. roughing stands, four 16-in., and six 13-in. intermediate stands, and eight 12-in. finishing stands. Final product from the finishing pass is coiled on laying type reels and discharged onto a series of flat conveyors. When rolling sizes larger than ⅜ in., the same roughing and intermediate stands are used, but the rods from No. 15 stand are diverted through repeaters into two 13-in. looping stands for finishing and then delivered to pouring reels. These reels discharge coils onto the conveyor system previously mentioned.

All of the roll stands are of cast steel and equipped with screws operated through worm gears for accuracy of top roll adjustments. Bottom rolls are adjustable to maintain pass elevation. Bearings are oil film type. Ten motors, totaling 13,500 hp, drive the 25 stands through pinion housings and gearing, all fully enclosed in oil tight casings. Finished rods are cooled by a series of water spray nozzles prior to entering the reels. Because of the high delivery speed of the smaller sized rods, laying reels are also equipped with forced air cooling which furnishes a high volume of cool air down through the coils. Each reel has a separate blower. Conveyor speed can be varied to suit desired rate of cooling for different rod analyses.

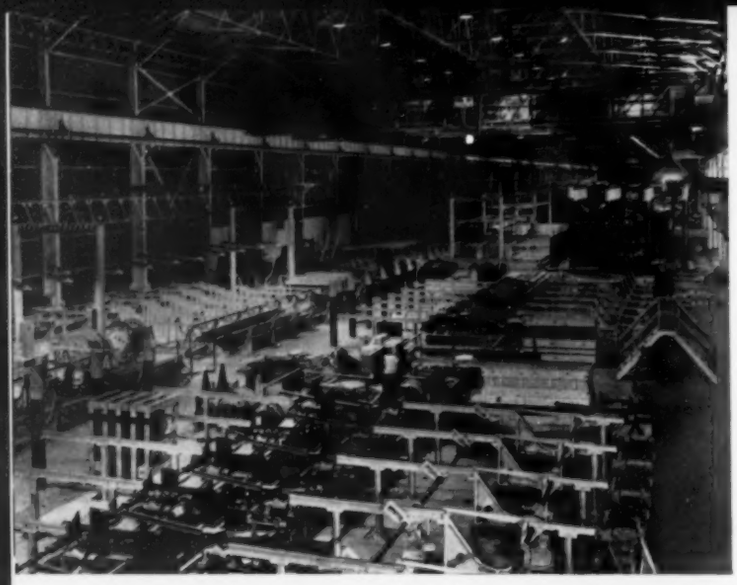
One of the interesting features of the Phoenix Manufacturing Co.'s Joliet, Ill., mill, which was recently completed, is that, instead of the conventional skew rollers, the bars are moved laterally on reversing tables by a sweep arm which lines up the bar for entry into the next stand. It is stated that this gives two advantages: the bar is under better control, and maintenance cost is lower than for skew type tables. This mill is a 6-stand, 12-in. mill, equipped for rolling railroad axles as well as billets, into flats, angles, reinforcing bars, round and special sections. Bars are transferred from stand to stand by reversing tables for heavy sections, and by repeaters for single or double strand operation on light sections.

In March, American Steel & Wire Division of U. S. Steel started construction on a new welded wire fabric mill which will have an annual capacity of 40,000 tons. Welding machines will turn out wire fabric in continuous lengths up to 13 ft wide. The equipment will

New tin plate shear shown, at J & L's Aliquippa plant, cuts material at speeds up to 1000 fpm.



Processing of nuclear materials is a new field for the rolling mill engineer.



Automatic handling of product features new pipe facilities at the Aliquippa works of Jones & Laughlin.

be capable of producing a pattern with squares as small as 2 in. Wire of 0.135 in. to ½ in. diam will be used.

Bethlehem Steel Co. has developed a mechanically activated wire coil stripping machine. It is designed for the specific task of stripping wire coils from spider reels after annealing and quenching. Stripping is a four-step operation. First, the spider reel, loaded with coils, is delivered by crane and deposited in a vertical position on the clamping platform. Next, an air-operated expanding gripper grasps the spider at its inner circumference. The machine then automatically rotates to a horizontal position, depositing coils in the cradle. Reaching this position, it trips a limit switch, and the spider is automatically ejected from the coils. After coils have been removed from the cradle, the operator pushes a button, the empty spider moves forward and the machine automatically returns to the vertical position.

At the beginning of 1956, Consolidated Western completed a new pipe mill near Provo, Utah, capable of manufacturing 40-in. high strength line pipe. The company also moved to this location an existing resistance-weld mill which can manufacture pipe up to 12¾ in. It uses submerged arc-welding and hydraulic expansion.

One company reports that it can produce seamless heavy wall pipe from any ferrous alloy by means of an extrusion press. The pipe can be extruded in lengths up to 50 ft or more, with outside diameters from 4 to 22 in. There are practically no restrictions on wall thicknesses.

The Mahoning Valley Steel Co., a subsidiary of General Electric Co., announced they would build a $500,000 tube mill at the Niles, Ohio, plant. Work was scheduled for completion late in 1956.

In the last few years there has been spectacular growth in mechanical flame scarfing, sparked by the need for higher quality steel, a tendency to make the steelmaking process more automatic, and the necessity for expanding steel production. One desirable feature is that mechanical scarfing makes it possible to roll directly from the ingot without interruption. The percentage of total ingot tonnage hot-machine scarfed in 1956 is estimated close to 20 per cent compared with 10 per cent in 1952. About a dozen machines were installed or under construction in 1956 alone, and ten of these are for processing semi-finished steel, 50 in. and wider.

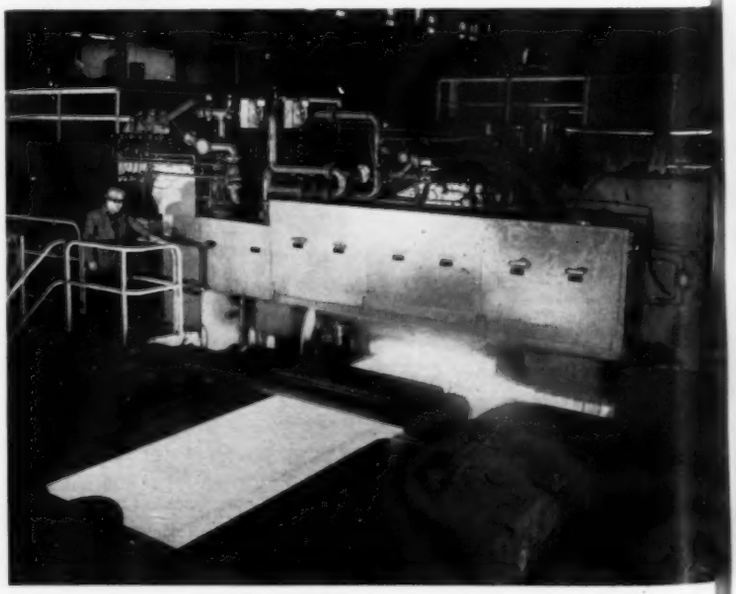
United States Steel's scarfer at Edgar Thomson Works went into operation in January and is the first unit to use natural gas. It will handle slabs up to 64 in. wide, scarfing all four sides. Weirton Steel Co., has a new unit handling slabs up to 50 in. wide, which went into operation in March. Late in 1956, a scarfer for a 44-in. blooming mill was installed at Gary. Wheeling Steel Co., is purchasing a scarfer to process slabs for its 66-in. hot strip mill. A total of about 60 mechanical scarfers are either operating or being installed at the present time. Most installations are single machines located between the mill and the shear. Ordinarily, they can be rolled out of the mill line on their own tracks. At Bethlehem's Lackawanna plant, there is a double scarfing setup with the first unit, a four-sider between the 40-in. blooming mill and the 30-in. mill, and the second unit between the 40-in. mill and the 21-in. mill.

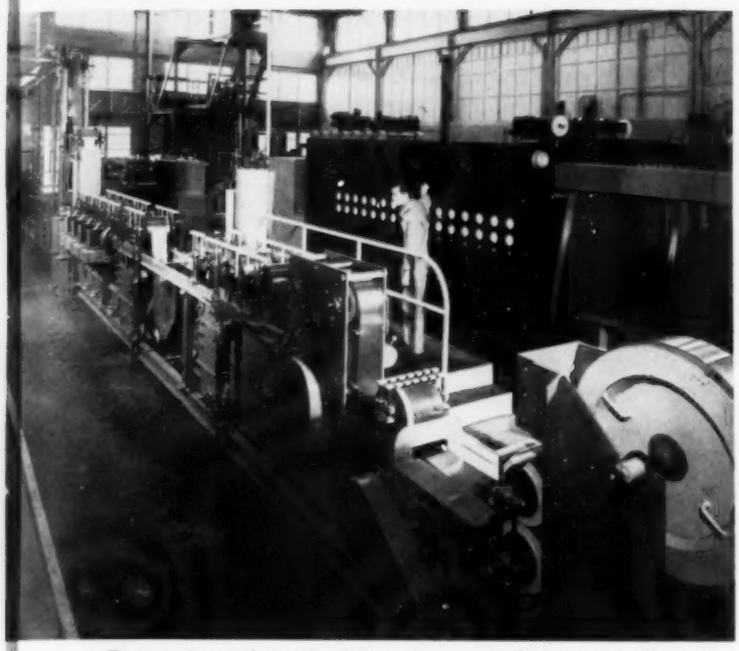
Most new machines are able to scarf all four sides of the steel. New developments in continuous slot nozzles in the machines result in a smooth, flat surface. The ridges which were produced by the older units with individual nozzles have been eliminated. Maintenance costs of the new units have been cut materially. Control of the units have been developed to the extent that it is possible to take off a uniform layer of steel 1/32 to ⅛ in. thick. Loss of metal by scarfing usually runs 1½ to 2½ per cent. Modern units can also scarf such items as stainless steel, using an iron powder flux. Straight chromium stainless steels can be scarfed satisfactorily without using flux.

FINISHING

The steel industry's efforts to produce a more salable, valuable and useful product by coating steels for corrosion protection, appearance and other purposes have continued without abatement. Additional equipment is being installed for tin plate and galvanized coatings. In addition, intensive efforts have been applied

In-line scarfing units are being extensively adopted. This unit at Edgar Thomson works of U. S. Steel burns natural gas.





Research work in the laboratory on pilot tinning lines has helped understand process.

to solving the problem of coating steels with other materials and considerable success is being achieved with coatings of plastic, aluminum, copper and other types. Much of this effort is being directed by the steel industry itself. Their success will enable the steel buyer to save on some of his production operations. Studies are also being made on the possibilities of porcelain-enameling stainless and other steels for high temperature applications.

In experimental production at U. S. Steel's Irvin Works is a line for coating cold-reduced sheets with liquid plastic. Expected applications are refrigerators, radio and TV cabinets, wall panels, automotive bodies and trim, etc. In the manufacturing process, steel is surface-treated to improve bonding and a specially compounded adhesive is applied to the top surface and cured by heating. After air cooling, the steel enters a coating chamber where a vinyl plastic is applied to the adhesive-coated surface. Heat then solidifies the plastic. The vinyl coating may be embossed prior to cooling to get the desired design or texture. Coatings have excellent abrasion resistance and good electrical resistance properties. The coating is also unaffected by humidity and many chemicals. The pilot line facilities at Irvin Works will produce 18 to 28 gage sheets from 24 to 52 in. wide.

Jones & Laughlin completed a new $6,250,000 continuous hot dip galvanizing line at their Pittsburgh plant. This unit uses the Armco-Sendzimir process and has a capacity of 7000 to 8000 tons of galvanized sheet a month. The line produces galvanized steel in both sheets and coils in gages from 14 to 30, in widths from 20 to 48 in., and in lengths from 60 to 168 in. It can operate for 13 weeks before shutdown for drossing and maintenance.

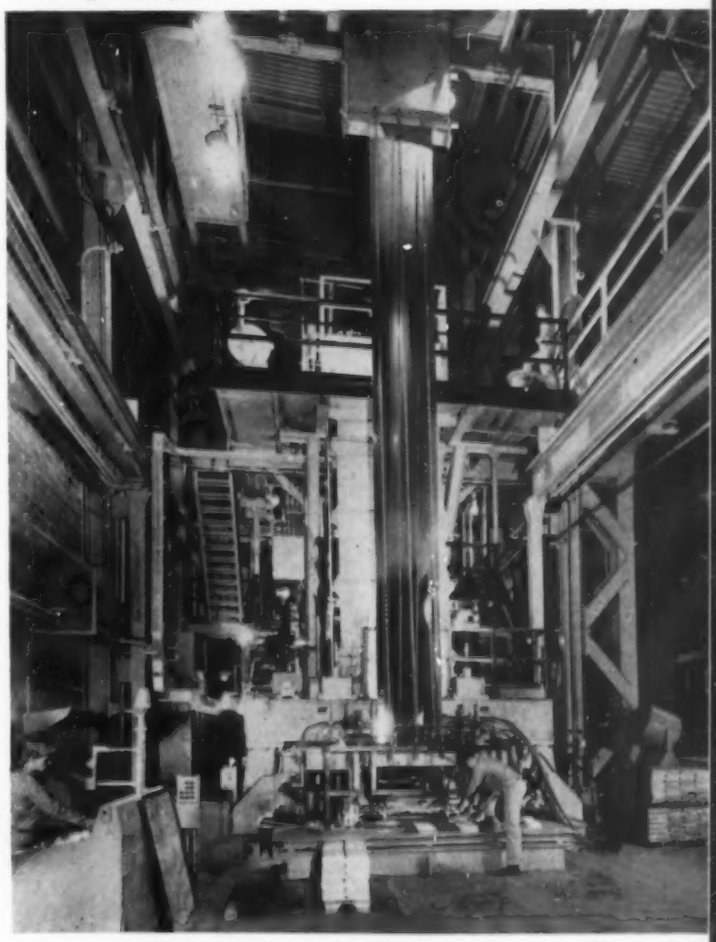
The Steel Company of Canada put a 48-in. continuous line into operation at Hamilton, Ontario. This line can turn out 10,000 to 12,000 tons of coil or sheet each month. The line is of the same general design as those at Wheeling Steel. An unusual feature is a three-station television setup from which the operator can view the main prime sheet piler, the scrap baller entry and either of the entry uncoilers. It is claimed that this type of line gives good adherence of the zinc to the steel. A small quantity of aluminum, kept mixed in the molten zinc by the thermal stirring action of an induction heating coil, minimizes the formation of brittle iron-zinc alloy between the base metal and the coating. An important factor in whether a steel company selects the type of galvanizing line used by Wheeling Steel or that used by Jones & Laughlin is the available annealing capacity, since in one case, the annealing unit is an integral part of the line, while the other depends on separate annealing facilities.

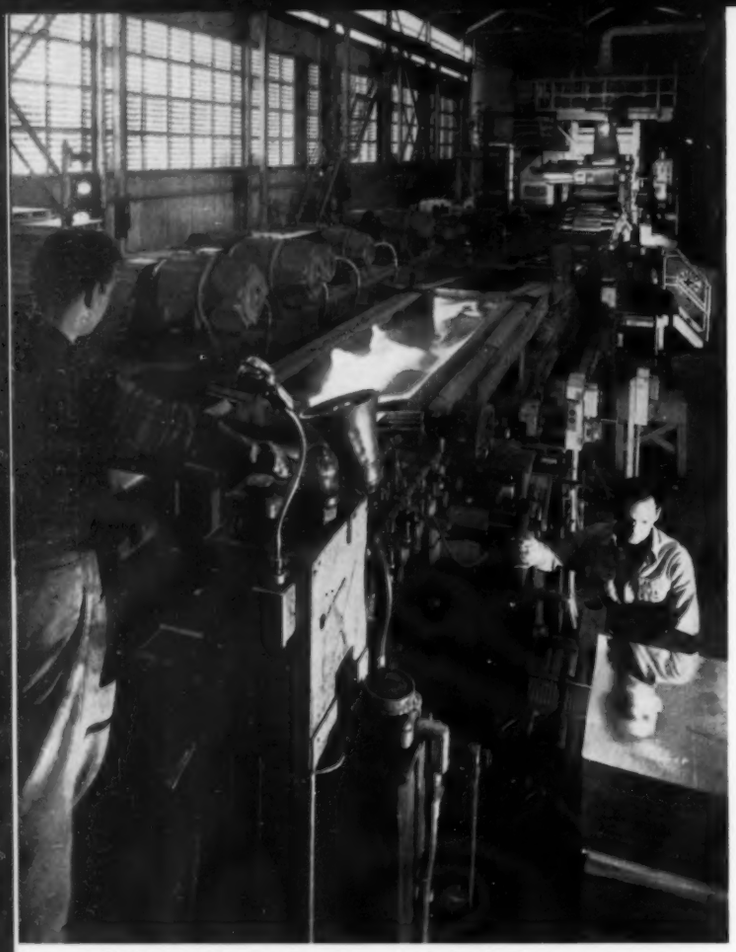
Granite City Steel put their first continuous galvanizing line into operation. The line can produce galvanized sheet in gages from No. 24 to 20 in. widths up to 48 in., and can produce coils up to 72 in. outside diam in weights up to 30,000 lb. The speed of the line is from 50 to 300 fpm. Granite City will use four existing galvanizing pots for hot-dip galvanizing.

Two 48-in. heavy gage continuous galvanizing lines were completed at Bethlehem Steel Co's Sparrows Point plant. These lines will coat 13 to 30 gage cold rolled steel strip, 18 in. to 48 in. wide at a maximum rate of 210 fpm. They are designed to produce either galvanized coil stock with a maximum diam of 48 in., or galvanized sheets in lengths of 60 to 164 in.

Republic Steel Corp. announced in August that they will install an electrolytic zinc plating line at a cost of $4,500,000 at their Cleveland plant. The line will

J & L put a new galvanizing line into operation in Pittsburgh this year.





Kaiser authorized a second electrolytic tinning line this year.

have an initial monthly capacity of 10,000 tons which may be expanded to 12,000 tons if desired. Equipment to be installed includes uncoiling machines, shears, welding machines, cleaning and dip units, a coiler and auxiliary equipment. The line will be able to handle steel coils weighing as much as 40,000 lb. Gage will run from a minimum of 0.015 to a maximum of 0.105 in. in widths up to 60 in. The finished product may be shipped as coils or cut to length and shipped as sheets.

The rush to the production of tinplate is not confined to the United States; most countries in Europe are also expanding capacities. Tinplate production in the countries behind the Iron Curtain was about 800,000 tons in 1956. This is much less than in the rest of the world, where perhaps some 7,000,000 tons were made. Strong efforts are being made by Great Britain to install additional tinplate facilities and production in 1956 was probably close to 1,000,000 tons.

In May, Weirton Steel Co. put into production their No. 5 tinplate line, a high speed electrolytic tinning line for differentially coating tinplate which operates at speeds up to 2100 fpm. Coils of 60,000-lb weight are produced, measuring up to 85 in. outside diam with a 16½-in. inside diam, in widths to 45 in. Drive motors totaling 2115 hp are used to propel the strip through this line. All drive regulating functions are performed with magnetic amplifier equipment. This line has a plating section with 21 cells on the first level and 11 on the second. On the third level, units reclaim the solution and scrub and dry the tinplate before it enters the 2400-kw induction reflow tower. The entire length of the line is 565 ft.

Hot-dipped aluminum clad steel wire is being produced on a new line recently installed at the American works of U. S. Steel's American Steel and Wire Division at Cleveland. This is a 16-stand, full scale production unit. New facilities are capable of producing aluminum-clad wire in sizes ranging from 6 to 18 gage in either 16 or 22-in. diam coils. Improved techniques have been incorporated in the line to obtain the required degree of surface cleanliness of the steel to be coated, to make sure of a complete aluminum coverage, and to obtain the required degree of ductility in the coating. Aluminum coating has many advantages over galvanizing, being very resistant to the effects of elevated temperatures.

The National Research Corp. has undertaken a long term research venture for Crown Cork & Seal Co. to develop a process to substitute aluminum for tin in making of tin plate for food and other containers.

An electrolytic machine for copper-plating stainless steel wire was installed by Republic Steel at Massillon, Ohio. This is the first equipment of its type installed in the cold finishing industry. It copper plates stainless wire in sizes from 3/16 to 5/8 in. diam. The copper plating varies from 0.0001 to 0.0002 in. thick, but can be varied considerably to meet customer requirements. The machine is a single strand unit. This material is used mainly for the production of bolts, nuts, screws and other fasteners.

A patent was taken out during the year on applying a protective metallic-oxide coating on metals. Coatings are metallic oxides of high melting point, such as oxides of aluminum, beryllium, thorium and zirconium. The process unites the powdered oxide directly with the surface to be protected, either by rolling, pressing or hammering. The layer is applied by spreading the metallic oxide in powder form compactly and uniformly between two sheets, and the whole assembly is then rolled, either hot or cold. When these sheets are separated, each sheet has a uniform protective coating on one side which adheres firmly to the metallic surface.

Bethlehem Steel Co. awarded a contract for the design and manufacture of a 48-in. continuous pickling line at the Sparrows Point plant. This line will be designed to pickle coils of hot rolled mild carbon steel strip up to 44 in. wide. The entry end will be geared for speeds of 1200 to 1400 fpm, and will be able to handle coils up to 56 in. in diam. Equipment at the delivery end will be geared for a speed of about 600 fpm, delivering coils with a maximum diam of about 73 in., weighing as much as 1000 lb per inch of width. The equipment will include pickling tanks, combination processor and straightener, two shears, and an electric flash welder to join the coils.

Bethlehem Steel Co. also awarded a contract covering the design and manufacture of four continuous cleaning and annealing lines for the Sparrows Point plant. Each line will be designed to handle cold rolled mild carbon steel strip 18 to 44 in. wide in gages from 0.0067 to 0.015 in. The lines will process coils with a maximum diameter of 73 in., weighing up to 50,000 lb, and will operate at speeds up to 900 fpm. Each line will include automatic electric flash welders, electrolytic cleaning tanks and continuous strip annealing furnaces with water quench tanks.

The country's first pilot plant for eliminating steel

plant waste acids, a cooperative project of seven steel companies and a supply company, went into operation in September at Republic Steel's Niles works. The plant converts spent sulphate liquors into useful sulphuric acid and iron oxide. It is hoped that the process will solve the problem of disposal of waste pickle liquor from steel plants. The unit in operation is a $500,000 pilot plant on which construction was started in April, 1956.

A research report on the factors which influence surface staining of cold rolled steel strongly indicates that the "snaky-edge" defect should probably be classified as an annealing defect, and the place to prevent it is in the control of the annealing operation. Recommendations for minimizing the occurrence of snaky edges include lower CO/CO_2 ratios, higher header pressure to insure increased gas flow rate, and perhaps inclusion of excess water vapor in the gas during the heating period.

FURNACES AND CONTROLS

To round out production facilities as ingot capacity was increased, and to obtain better product with fewer defects, heating facilities of all types were constructed or rebuilt in practically every plant in the industry. These units emphasized increased instrumentation both for control (important in obtaining quality) and record-keeping purposes. Generally, furnaces featured higher Btu inputs and ability to use various fuels.

The increasing demand is resulting in a substantial increase of facilities for the production of silicon steel. U. S. Steel Corp. at Vandergrift finished installation of ten cover-type annealing furnaces with 27 bases. Early in 1956, at the same plant, continuous annealing facilities for silicon steel were put into production. These lines handle strip widths from 18 to 42 in. in thicknesses of 0.007 to 0.031 in. Nominal production capacity is 40,000 lb per hr of 0.014 in. x 30-in. strip at a strip speed of 460 fpm on stress relief cycle, and 16,000 lb per hr for 0.014 in. x 30 in. strip at a strip speed of 184 fpm on an anneal cycle. Electric heating is utilized throughout to provide strip temperatures of 1650 F on the anneal cycle, with a maximum furnace temperature of 2000 F.

New plate heat treating line at Lukens Steel features a number of innovations, particularly in control.

Wheeling Steel Co., increased finishing capacity for electrical steel at the Beech Bottom works by 50 per cent at a cost of about $500,000. As part of the project, the old style annealing furnaces were removed and replaced with a new continuous strand furnace for silicon steel, which went into operation in the summer of 1956. This unit enables Wheeling to enter the market for cold reduced electrical steel in coils. High temperature available in the furnace will facilitate limited production of grain-oriented grades of electrical steel.

Total length, including coiling equipment, shears, welders, etc., is over 200 ft. Maximum strip width is 36 in., and furnace capacity is 6200 lb per hr. It is heated with both gas and electricity. A special generator will provide several different chemical combinations needed in the furnace atmosphere when producing electrical steel. Wheeling also awarded a contract for installing single-stack annealing furnaces at their mill at Yorkville, Ohio. The project includes 17 single stack furnaces and 50 bases to be used exclusively for tin plate coils. Units are designed for coils 72 in. maximum diam and a pile height of 156 in. Estimated cost is $700,000.

Recent test work at the Steel Company of Canada on continuous annealing indicate that the recrystallization temperature of low carbon steel is somewhere within the range of 1100 to 1120 F when the fast heating times common with continuous annealing are used. The time above recrystallization temperature, which is the real

Operation started this year on the new pilot plant for processing spent pickle liquor.

effective soaking time, can be correlated with hardness change during annealing. The time at maximum temperature, however, seems to have little influence upon the hardness, and two to four seconds are enough. Hardness of low carbon steel decreases progressively as higher annealing temperatures are used up to a maximum of about 1333 F. Up to this point, each 50 F rise in temperature reduces hardness by about one point on the Rockwell 30-T scale. The relationship of maximum temperature to hardness is not linear for temperatures below 1170 F. Maximum temperatures in the ranges from 1333 to 1400 F seem to increase the hardness. Above 1400 F, the steel may again become softer. The cooling time from maximum temperature to 1100 F seems to be of secondary importance. The maximum quenching temperature is 600 F. The minimum effective cooling time is 25 seconds. Increasing the amount of carbon, nitrogen, phosphorus, tin and molybdenum in the steel may be expected to cause a marked increase in hardness. An increase of about one point Rockwell 30-T hardness may be caused by increasing the carbon content by 0.01 per cent or the phosphorus by 0.02 per cent.

In the new slab heating furnaces which serve Weirton Steel Co's hot strip mill, four closed circuit television cameras assist the operator to control furnace operation. The operator, who is 350 ft away, can control the steel slabs from the furnace to the rougher, and in transit on the tables from the roughing to the finishing stands. One camera is mounted so that it scans the 350-ft delay table and the other three cameras are located at the side of each of the three reheating furnaces, a few feet from the discharge end. When the charging door of any furnace is opened, the camera at the exit end of that furnace is automatically activated and its picture is switched on the operator's monitor. Watching the monitor, the operator can watch slab movement within the furnace.

Youngstown Sheet & Tube awarded contracts for an 80-ft diam rotary hearth billet heating furnace, and a 58-ft wide x 70-ft long, 3-zone tube normalizing furnace. These will be installed at Youngstown's new seamless mill at Indiana Harbor, Ind. Each unit will be able to handle 100 tons per hr continuously. The rotary furnace will be equipped with an automatic charger and discharger.

National Supply Co. installed new continuous normalizing equipment for oil well tubing during the year. All pipe handling, conveyor speed and furnace temperatures are under instrument control, making it a one-man operation.

U. S. Steel Corp. started construction during the year on a heat-treating facility at its Homestead plant. The new line is being designed primarily to quench and temper alloy and stainless steel plates. It will give better flatness and other mechanical properties not possible with conventional facilities. The line will be 858 ft long and will be located near the existing 160-in. plate mill. The unit includes two continuous heating and hardening furnaces with high pressure water quenching systems, a separate in-and-out furnace for stainless steel plates, processing tables, two 25-ton gantry cranes, a roller leveler and piling beds.

Kaiser Steel Corp. is installing four blocks of soaking pits at their Fontana plant. Each block will have two pits capable of holding 120 tons of steel. The existing pits are also being enlarged to hold 120 tons each. The pits are part of the expansion based on the new oxygen converter steelmaking units.

Republic Steel Corp. installed a new continuous bright annealing furnace at their steel and tubes division. This unit will give high quality finish on welded stainless tubing from 1.4 to 4-in. outside diam. It has a rated capacity of 1000 lb per hr and maximum temperature of over 2100 F. The furnace consists of four high-temperature alloy steel muffle tubes extending through a gas-fired furnace and connected with tubular water-cooled chambers. Alloy wire mesh belts carry the work through the furnace.

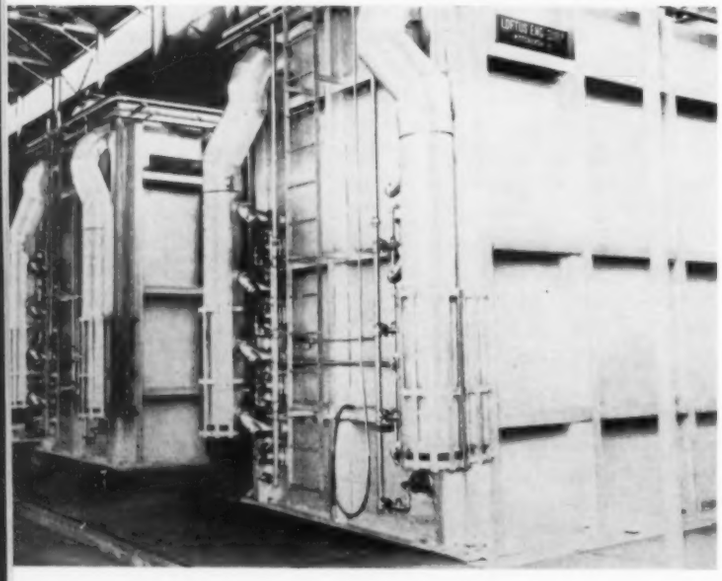
An American manufacturer is marketing another metallic recuperator of German design. These units consist of shell and tube heat exchangers of heat resistant alloys. They offer the advantages common to metallic recuperators and will provide air temperatures up to 1400 F.

In last year's development story, brief mention was made of a process for heating steel in a direct-fired furnace without forming scale. Additional information on this furnace indicates the principle of the process is the operation of burners with about 50 per cent deficiency of air. This air is preheated to give the high temperature required. The products of combustion, which are high in hydrogen and carbon monoxide form an atmosphere that is essentially nonscaling. The remaining air needed for combustion is added in a regenerator which is used to preheat the primary combustion air, thus making full use of the heat value available. The atmosphere within the furnace has a CO content between 12 and 16.5 per cent.

The furnace has two metallic regenerators. As the furnace is fired alternately from the burners on one side and then from the opposite side, products of combustion flow first through one regenerator and then through the other in a reversing regenerative system similar to the open hearth furnace. It is claimed that this type of atmosphere control can be applied to continuous furnaces of the straight-through and rotary type, as well as to batch type units.

Another new process for descaling steel announced

New annealing facilities at the Vandergrift plant of U. S. Steel provide additional capacity for electrical steels.



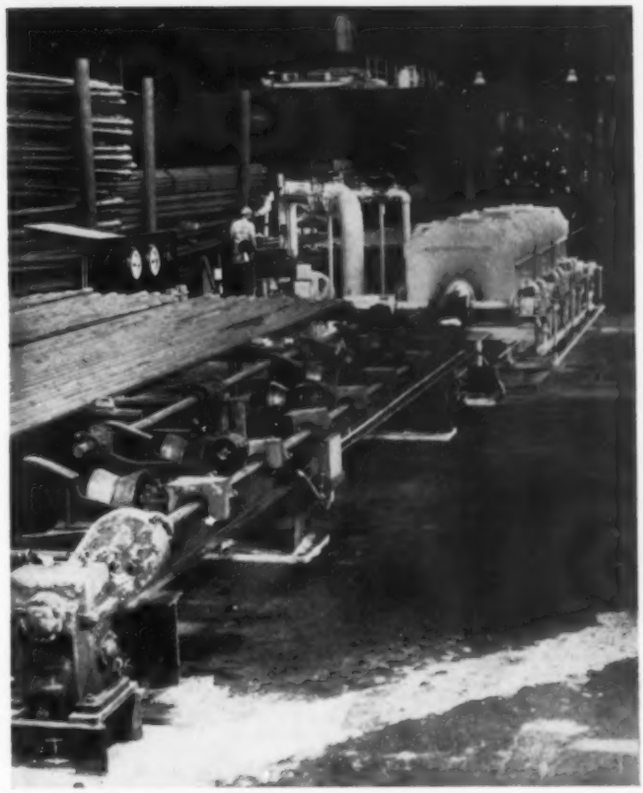
during the year uses the principle that furnace scale can be liquefied and removed from the steel at a much lower temperature than the fusing temperature of scale, which is ordinarily above 2550 F. In this process, lime or lime-bearing material is applied to the steel which has been heated to forging temperature. At about 1975 F and above, the mixture of lime and scale becomes fluid and can easily be removed. A typical application will be the removal of the scale from billets for extrusion. Lime may be easily applied by blowing it through a port in the furnace as the billet approaches the exit end. It is stated that the process is applicable to all carbon and low alloy steels. It is not effective for steels which contain large amounts of chromium or nickel.

An interesting patent shows an innovation in the heating of steel billets for hot working by extrusion or forging. Billets are run through a furnace suspended from a conveyor trolley but a stud welded to one end. Before being carried to the furnace, which is of the radiant panel type, the billet is coated with a coating of glass frit and clay in water, which fuses in the furnace and seals the billet from contact with the oxidizing furnace gases. Heating is accomplished in four to five minutes per inch of billet diameter which also minimizes oxidation. When the billet is chilled by air, the surface of the coating becomes highly abrasive. Borax lime or barium chloride therefore is dusted or blown on to flux the coating and liquidize any abrasive residue on the billet, preventing formation of pits or marks on the billet. The stud is sheared off. After forging or extruding, the product is cooled in air or water quenched. A light pickle then gives a good surface finish.

What may be the largest vacuum annealing furnace in the U. S. was installed by Mallory-Sharon for titanium processing at Niles, Ohio. This unit was designed with the specific requirements of titanium in mind. Sheets can be loaded either flat on a charging car, which is then rolled into the furnace, or they can be suspended vertically. Flat loading eliminates waste resulting from punching of sheets for vertical handling, and also streamlines handling. The furnace has a charge space of 4 x 4 x 12 ft and can process several tons of material per charge. It has a rating of 450 kw, a maximum operating temperature of 1600 F and can be evacuated to 0.000001 of an atmosphere. Insulating materials were eliminated in this furnace design, and no refractory brick linings are used, since most of the heat transfer in the furnace is by radiation rather than convection. Radiation shields serve as thermal insulation. Exterior of the furnace is water-cooled to prevent distortion by warping. Vacuum annealing will be used when required to reduce the hydrogen content of finished titanium sheet materials. Present specifications normally call for no more than 150 ppm of hydrogen in titanium sheet.

A very large installation of 60-cycle induction heating equipment for copper, brass and cupro-nickel were installed at Revere Copper & Brass' plant near Rome, N. Y. This equipment, which consists of six electric induction coils mounted parallel to each other, will feed billets to a 3500-ton extrusion press at more than 10 tons per hr. The unit requires 6000 kva.

It is reported that a German company has put into operation a resistance heating process for small billets for rods and bars which will bring them up to a temperature of 1800 F in one minute. As a result, scaling,

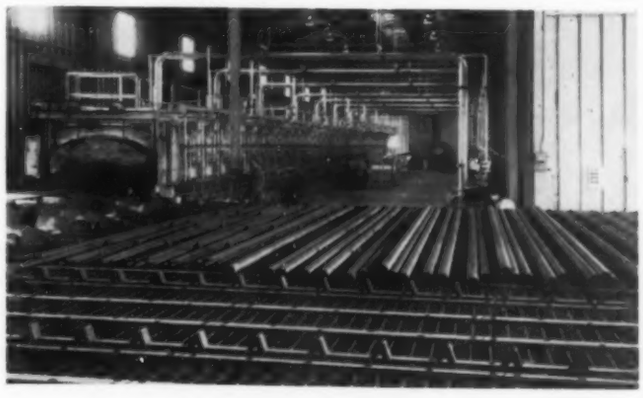


Oil well tubing normalizing equipment with instrument control makes this a one-man operation at National Supply's plant.

cracking and surface decarburization are markedly reduced.

An electric cascade control system applied to billet reheating furnaces is so arranged that furnace zone indexes are readjusted automatically to compensate for mill delays. Control-wise the furnace is divided into three zones, preheat, heating and soaking. When steel is moving steadily through the furnace, preheat zone temperature is low. When the preheat temperature is normal or low, zone temperature control operates in the conventional manner. When the rolling rate is slowed down below normal, the preheat zone begins to pick up temperature. When this temperature level reaches the preset control band, the preheat controller electrically readjusts soaking zone temperature index down scale proportionately to the rise in preheat temperature. As the soaking zone temperature is reduced, this change is transmitted to the heating zone controller which in

A new roller hearth furnace was installed at Timken's plant.



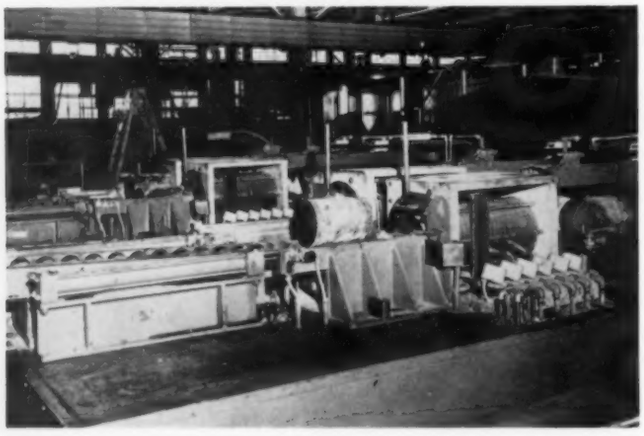
turn is given a lower set point. The soaking and heating zone controllers are held under the influence of the preheat controller until the normal rolling is resumed and the preheat temperature drops below the control band. Former trouble encountered in the soak zone with billets sticking together has been practically eliminated. Another gain is more uniformly heated billets regardless of the rate of mill operation.

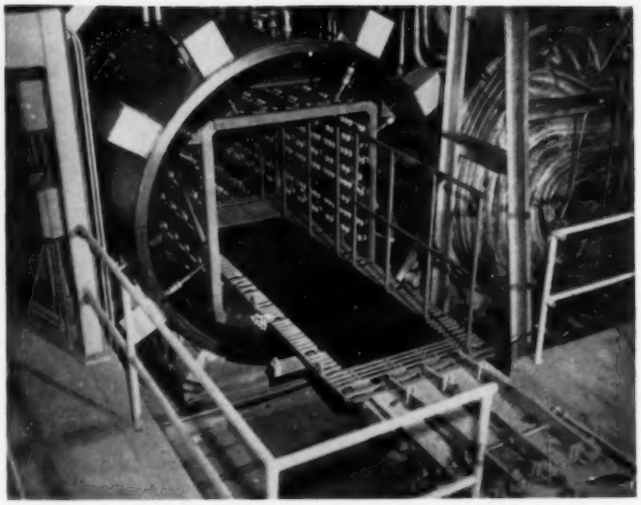
A new capacitance control was shown for the first time in this country. This unit senses minute changes in capacity and converts them into pneumatic signals. It has many potential uses in continuous process applications for control of changes in level, moisture content, etc. Another new instrument is a pyrometer that has a sensing element mounted behind an opening in a gold-plated hemisphere which reflects instead of absorbs heat rays. The readings are virtually instantaneous.

A magnetic oxygen analyzer announced during the year is based on the strongly paramagnetic nature of oxygen. A feature of the analyzer is that it eliminates auxiliary gas tanks, combustion and chemical reactions. The equipment operates as follows: A hot wire is suspended in a magnetic field and when paramagnetic oxygen passes through it, a convection current is set up which cools the wire. The strength of this current, the temperature of the wire, and therefore the resistance of the wire, depend on the amount of oxygen passing through the field. This is measured and the device gives a reading directly in per cent oxygen. A reference cell is used to cancel out other variables, such as changes in barometric or static pressure.

A new gas sampling system also has been developed for use with the magnetic oxygen analyzer. It solves the problem of getting a continuous dirt-free sample with a minimum of maintenance. In a typical unit for the open hearth, sampling tubes are installed in each downtake and connected by ¼-in. copper tubing to the analyzer. The analyzer and its recorder can be located up to 200 ft from the sampling point with as little as five seconds lag in the sampling system. One of these systems is installed at Jones & Laughlin's Pittsburgh plant. Here the recorder-controller is used to automatically adjust the fuel-air ratio in an open hearth furnace for optimum combustion efficiency. The sampling system comprises a water-jacketed probe, a steam ejector, a jet condenser and a centrifugal separator. The sample probe has an outer jacket through which water continuously circulates to cool the tube. In the center of the probe, a tube carries filtered water to a nozzle assembly which washes the probe opening with jets of water, keeping the end free of slag. The mixture of flue gas and wash water are drawn from the probe by the steam ejector. Steam thoroughly mixes with the gas and dirt, and the mixture passes to a jet condenser. Water and dust are removed in the centrifugal separators, and the clean gas sample is delivered to the analyzer.

These three 60-cycle induction heaters were installed in a brass mill. Power at 6000 kva is required.





This vacuum annealing furnace is charged horizontally.

A unique instrument acts as a silent watchman to warn of gas leaks at remote locations. The instrument has cones which collect samples of the atmosphere, sounding an alarm by remote control when combustibles are present. Because of the automatic alarm, personnel need visit the station only occasionally to collect and replace charts. Samples of the atmosphere are drawn into the instrument and pass over one or two heated sensitized platinum filaments which are part of a balanced electrical circuit. Any combustibles present in the air sample drawn over the detector filament will burn as they come in contact with the heated wire. This increases the temperature of the filament, and consequently its resistance, unbalancing an electrical circuit in proportion to the concentration of combustibles. This in turn is measured by a relay, setting off an alarm.

A new continuous pneumatic integrator, capable of totalizing rapidly fluctuating and intermittent flows, is a pneumatic fly-ball unit used with a pneumatic differential pressure drive transmitter to totalize liquid and gas flows of virtually any characteristic. The equipment is based on an ingenious application of the principle of centrifugal force, which extracts the square root factor introduced by the differential pressure measurement, so that integration of flow is linear.

MATERIAL HANDLING

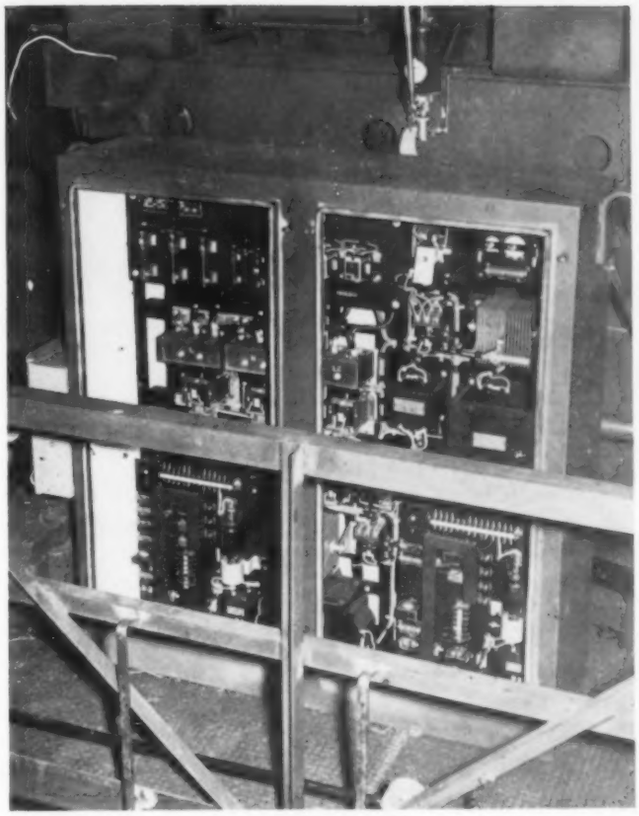
Size of material handling equipment continued to increase during the year. Unusually large are three 500-ton ladle cranes for a large eastern steel plant, which will operate in a new open hearth shop to service seven large open hearth furnaces.

What may be the largest crane ever built abroad was built by the Australian Iron & Steel Co. This is a 410-ton (gross) ladle crane with a span of 75 ft and a width

of 69 ft-6 in. The crane is of the four-girder type with an auxiliary trolley with two hoists of 65 and 15 gross tons capacity. The main load is carried by 60 falls of rope reeved on two drums, each 7-ft in diam. Box section girders are used for the main and auxiliary girders. The bridge is carried on 32 wheels, eight of which are driven through a double drive, one on each side of the bridge, with two motors at each end connected by a high speed cross shaft.

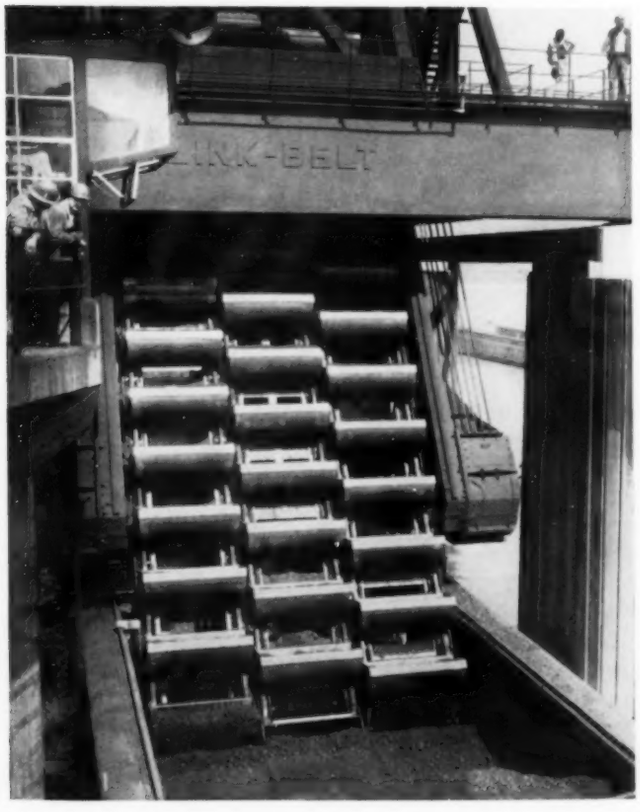
A very ingenious design replaces the ordinary electric motors on a crane with a hydraulic system. The only electric motor used is one to operate the hydraulic pump. A 3-ton crane has already been built and designs have been prepared for cranes up to 10 tons. All power for the crane motions (hoist, trolley and bridge) is supplied by a hydraulic pump driven by a 10-hp squirrel-cage motor. The trolley mechanism consists of a hydraulic motor connected to a speed-reducer unit. This drives the trolley through a roller chain running the length of the bridge girders and back to the ends of the trolley. A similar motor, connected to speed-reducer units at opposite ends of the bridge, drives the bridge. The hoist mechanism consists of a hydraulic cylinder, piston and rod with a 4-ft stroke and two cross-heads on top of the bridge girders, each carrying six cable sheaves. The cable is reeved over the cross-head sheaves before passing to the trolley sheaves where it loops downward to the lifting block.

An electronic system allows remote control of traveling cranes from the plant floor. No additional power circuits are required, as carrier current over existing power rails is all that is needed. With this control, the operator can raise or lower the hoist, position the trolley, move the bridge, energize a magnet, all from the floor. One power circuit can be used to control as many as eight cranes by use of different carrier frequencies and one operator can operate more than one crane. With two control panels, the crane can be operated by one man, sent to the other end of the shop where another man can unload it and send it back. In actual operation, high speed synchronous relays on the crane and floor panel operate whenever levers are moved. Carrier frequency on each step is shifted down to a lower frequency for an *OFF* control, and up to a higher frequency for an *ON* control. Whatever control signal is sent during an operating cycle is stored by a "sealing-in" relay until changed by another operating cycle. The small relays, which operate in a few milliseconds, are repeated by contactor type relays for the actual control.



Electronic control is being used on some cranes.

As plants expand, additional material handling facilities are being installed.



Adjustable voltage on ore bridges is becoming a standard application. Among the advantages are less trolley weight, better acceleration rates, higher capacity for a given mill motor, less mechanical maintenance, higher hoist and trolley speeds, and better control.

A scale car introduced during the year uses pneumatic dumping, drawing its air from the same supply as the air brake. It contains two 160-cu ft bins. The car is motor driven and travels at speeds up to 500 fpm with full load. The weighing equipment is new, consisting of an automatic recording scale which, at the press of a button by an operator, weighs the bin loads and automatically records them on a tape.

A new railroad car, put into test operation this year, should be able to handle steel coils with less damage and at less cost. The car is designed to eliminate damage due to load shifting, impact or weather. It also cuts loading and unloading time. It consists of two cylindrical metal shells fitted lengthwise on a standard railroad flat car. A man can open the cylindrical encasement in 45 sec.

Special car will handle coils with less damage.

Giant ram truck has revolving ram and capacity up to 100,000 lb with special counterweighting.

An extensive conveyor system is being installed at U. S. Steel's new ore screening and sintering plant at Youngstown, Ohio. The conveyor system consists of 40 separate units totaling more than 7100 ft in length. The screening and sintering plant will handle iron ore shipped by rail. Conveyors will transfer the ore from the rotary car dumper to the plant at a rate of 3000 tons per hr.

Weirton Steel Co. is the first steel plant to install conveyors for handling human traffic. Employees are carried up 3½ flights from the mill floor to a new consolidated locker room. The installation is a 4-unit moving sidewalk. The conveyor consists of a 24-in. belt which moves up a 13-degree incline at a rate of 130 fpm or about one-half normal walking speed. Unit can handle up to 3600 persons an hr.

A new continuous coal unloader at U. S. Steel's Clairton works replaced two coal hoists. Three continuous bucket lines lift the coal from river barge to the crushers. Coal then takes a 453-ft conveyor ride to one of the four 1500-ton mixing bins.

The use of pipe lines for handling heavy bulk solids over long distances received another boost with the announcement that a 70-mile pipeline will carry gilsonite ore from the mines at Bonanza, Utah, to a coke processing plant. This line will traverse rugged mountain terrain. It will be 6-in. pipe buried below the frost line, and will carry a slurry of gilsonite and water in which the slurry concentration will range between 20 and 60 per cent. The line is expected to move 630 tons of gilsonite per day.

Featured on the new lift trucks put on the market during the year are higher lifting speeds, better visibility through the mast, automobile type dash board and controls, more attachments, "dead man" brakes, automatic transmission, greater driver comfort, and special engines. A number of LP gas trucks are also now on the market.

A truck developed for steel mills uses a revolving ram which can lift and carry up to 70,000 lb, and with additional counter-weighting, up to 100,000 lb. This unit was designed for transportation and storage of steel coils in a Welsh rolling mill. Because the load ram will revolve, the truck can wind up the loose ends of the coils as it transports them, eliminating the need for manual winding or steel strapping. The truck is also equipped with an attachment which will up-end coils and stack them vertically.

The rotation unit consists of a 90-degree rotator, offset approximately 45 degrees from the vertical. A clamp and ram unit holds the coil securely during rotation, preventing it from telescoping. The attachment may be removed for installation of forks or ram.

One truck manufacturer introduced a line of trucks in which eddy current braking for the hoist is a feature. This enables precise control of the load.

Another interesting development which can make a truck completely automatic is a system of photocells and guide lines which automatically steer a moving mechanism. The photocells trace a light source which illuminates a painted stripe or tape. These are combined with amplifiers and servomotors to form an automatic steering system which guides the moving vehicles. Any white line, painted or plastic tape which will give a minimum of a 3 to 1 ratio to background light reflection, placed on the floor of a warehouse or street, will act as a route of travel for the truck. If the truck goes off the white line, safety controls apply brakes and shut off power.

MECHANICAL

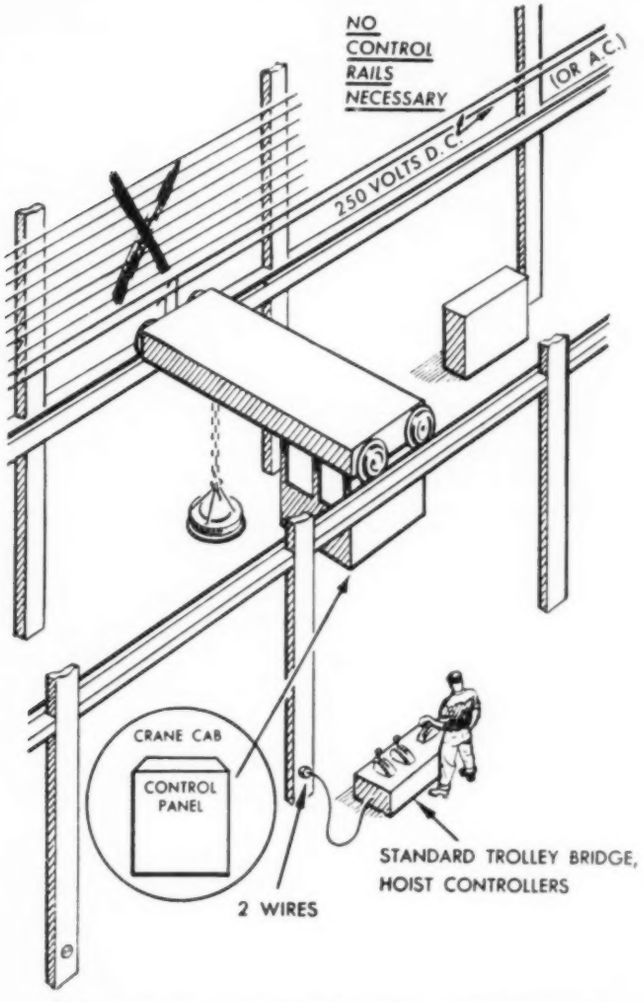
In the field of power generation, the possibilities of nuclear power still held the forefront of attention. Constant progress was made during the year in every principal aspect of the nation's atomic energy program. These developments are beyond the scope of this report. Consequently, only brief mention will be made of a few high points.

Perhaps one of the most important steps was the President's approval last February of recommendations of the AEC to make available some 40,000 kg of special nuclear materials for fueling power and research reactors in this country and abroad.

Most nuclear power reactors now operating are used in research studies and for special military purposes. As yet no commercial unit is in operation in the United States, although the unit being built by Duquesne Light at Shippingport, Penna., is nearing completion. In England, the first commercial unit went into operation recently.

The new plant in England is at Calder Hall. It is important because it is the first unit to generate power from nuclear materials on a commercial scale. It also is the first of 12 nuclear power stations which the British plan to build under a 10-year, $980,000,000-program. The plant at Calder Hall produces electricity mainly as a by-product to its main function which is to make plutonium for military use. Most of the other plants will be designed for maximum power output with plutonium as the by-product. Calder Hall has two reactors, each of which uses carbon dioxide to carry the heat, and can support 92,000 kw of generating capacity.

Of perhaps more immediate interest to the steel industry is the growing demand for special alloys and materials produced by the steel industry for use in the atomics industry.



Remote crane control system uses carrier current.

The first privately built plant to make atomic products was put into operation by the Babcock & Wilcox Co. at Lynchburg, Va. This plant provides facilities to manufacture and test nuclear fuel elements. The operation is similar to many metal working operations in that metal casting, rolling, welding and machining equipment are required.

A turbine-shaft gear propeller unit that can be hooked onto an atomic reactor system is being designed by Bethlehem Steel Co. This will be used in the Navy light cruiser program. Designers estimate that the weight problems associated with shielding the nuclear reactors are offset by the additional space which is gained by eliminating the conventional fuel compartments.

In power plants, aluminum is being applied to a limited extent for the tubes in surface condensers. This is due to a number of corrosion studies made on a small number of aluminum tubes installed on various condensers around the country. A utility plant in Wisconsin uses all-aluminum tubing in a 105,000-sq ft condenser.

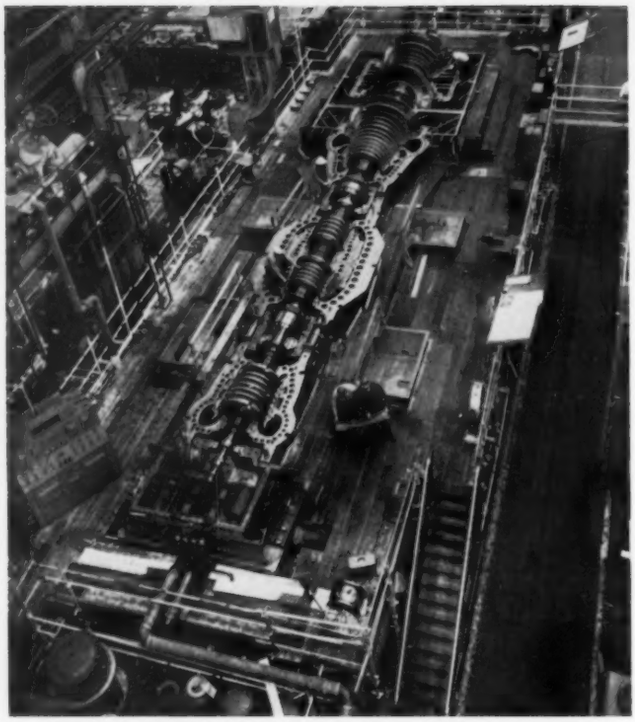
An electronic instrument that continuously measures the clearance between the rotating and stationary blades inside a steam turbine was developed by the National Bureau of Standards. The instrument may help solve the problem of maintaining a safe axial clearance between the rotary and stationary blades.

One of the world's largest installations of gas turbines to be used for the generation of electric power is scheduled to go into operation in 1957 at Victoria, British Columbia. The units comprise two 19,850-kw, single-cycle, single-shaft units, and two 18,000-kw, regenerative cycle, single-shaft turbines. Each gas turbine will drive a 3600-rpm, three-phase, 60-cycle hydrogen-cooled generator.

The first steel mill gas turbine installation to use a waste heat boiler was ordered by Altos Hornos de Mexico, S. A., for Montclova, Mexico. Exhaust gases at 750 F will be used in the waste heat boiler to generate steam to drive a steam turbine. The 8100-kw gas turbine will operate at 4700 rpm, and will consume 3,655,000 cu ft of natural gas daily. Gas will be supplied by a 200-mile pipeline. The gas turbine was selected due to a limited water supply.

One large manufacturer set up an engineering calculations center which uses the most advanced commercial electronic computers in the United States. One of its main purposes will be to aid in the development of steam turbine-generator units for electric utility companies. Such computers and computing centers are being installed by many companies to cut down the drudgery of long-time calculations and also to make calculations which had been considered previously impractical because of the long periods of time which would be involved. Another company is using similar procedure in piping calculations.

New protective clothing should help reduce downtime.



Automatic extraction steam turbine is designed to handle 2,800,000 lb of steam per hr.

The increasing trend toward the use of oxygen both within and without the steel industry has resulted in almost doubling the oxygen-producing facilities of the country in a period of about two years. Most of the new installations have been located in or near steel plants. Many are high-purity gaseous oxygen producing units ranging from 7,000,000 to about 100,000,000 cu ft per month capacity. Most of them are backed up by liquid oxygen reservoir tanks to meet peak demands and to serve during maintenance downtime. Most of the capacity is going into metallurgical and production operations such as blast furnaces and open hearths.

A paper presented at the AISE fall convention this year gave interesting data on the economics of the use of oxygen. This study showed that the cost of oxygen can vary, depending on the purity and the demand conditions, from about $25 a ton for a generating station producing seven tons of oxygen per day down to less than $5 a ton, for a plant producing 500 to 700 tons per day.

The oxygen-blown converter uses about 2000 cu ft of oxygen per ton of steel produced. When used in blast furnaces, about 1000 cu ft of oxygen is used per ton of iron produced. In steel plants where oxygen is used, some 500 cu ft of oxygen per ton may be used for combustion, some 300 cu ft per ton for lancing and about 250 cu ft per ton for scarfing. It is estimated that by 1961, oxygen consumption will rise to an average of 650 cu ft per ton for all steel produced, due to adoption of additional procedures which will use oxygen. At the present time, about 175 cu ft are used for every ton of steel produced, three and a half times that used in 1940.

A recent analysis of three steel mills showed scarfing operations were the biggest oxygen consumers, using more than half the total annual consumption of nearly 2,000,000,000 cu ft in these mills. A large scarfing machine which scarfs four sides of the slab can use as much as 560,000 cfhr of oxygen in a continuous operation.

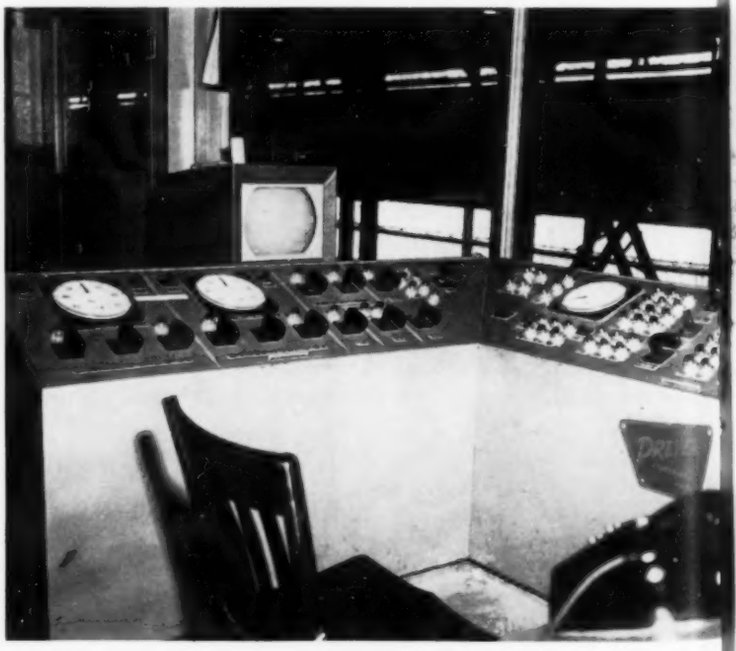
Another gas which is finding increased usage is carbon dioxide. One application is in the foundry, where the use of carbon dioxide speeds up the making of cores. It has been found that, when cores and molds are made with a mixture of sodium silicate and sand, they harden in seconds when carbon dioxide is passed through them. The gas combines with the sodium silicate binder to form a silicic acid gel which cements the sand grains together. As a result, the time of making and baking cores is reduced, capital equipment requirements are much smaller, and the operation becomes a great deal more flexible.

A new process makes nodular iron without annealing and without introducing other elements with the nodulizing agent. In this process, instead of using sodium and magnesium as a nodulizing agent, the halides of these metals and a reducing agent are added to the molten iron in the form of sodium and magnesium chlorides with calcium silicide as a reducing agent. No violent reaction takes place as a result of the addition. Examination under the microscope shows excellent nodular metallurgical structure is obtained.

An article of protective clothing will enable a man to work in temperatures as high as 1200 F. In one demonstration, a man wearing a protective suit walked into a furnace heated to 1200 F several times and stayed two or three minutes each time with no ill effects. The suit consists of material coated with a thin layer of aluminum which reflects the radiant heat instead of insulating against it. Under the aluminum coating is a layer of glass fibre quilting. Such equipment may minimize downtime for repairs in hot areas.

As a result of the search for better lubrication, there has been a boom in the use of multipurpose oils and greases, and a continuous search for better special purpose lubricants. Many extreme conditions are being met with synthetic type lubricants. Among the syn-

Use of a large number of TV units is aiding control of steelmaking operations.



thetics, silicones and molybdenum disulphide are meeting with the greatest interest. The most significant trend, however, is the development of multipurpose properties, blending additives to a proper base so one lubricant will do many jobs. Greases which are coming to the forefront are lithium, bentone, calcium and barium, of which lithium is perhaps the most popular. These greases have very good mechanical stability and work well from temperatures as low as minus 30 to 250 F.

A new lubrication cycle counter gives visual proof of proper lubrication and also provides a permanent record of bearing lubrication. This counter registers the exact number of times that the lubricant valve is discharged and shows at a glance that the lubrication system is functioning at the predetermined intervals. The unit is furnished as a kit which can be installed without removing the valves from the centralized system. It screws into the valve, and extends but 1⅝ in. out of it when in operation. The piston action of the valve actuates the counter mechanism at every cycle.

Two new lubricators for applying oil mist have been designed to give a 48-hr week of continuous lubrication for up to 300 or 500 bearings, using only one-tenth as much oil as other methods of lubrication. These units use compressed air to atomize the oil into mist which is then distributed through tubing. The system is operated from the machine's on-off switch. It has no moving parts and requires only filling of the oil reservoir.

Another fire resistant hydraulic fluid was put on the market during the year. This material resists fire when poured on molten or hot metal and cannot be ignited by an oxyacetylene torch. It is claimed that it can replace any conventional fluid, and the cost is said to be much less than that of the synthetic oils. It is a special formulation of water, petroleum hydraulic oil and emulsifying agents. Combustion is eliminated by the release of the water content of the fluid, forming a protective steam blanket to quench the fire. This in turn reduces local temperatures and displaces oxygen from the immediate area, so that the remaining fluid will not support its own combustion.

Increased machining speeds are available as new cutting materials come into use. New ceramic materials are extending the ranges and speeds above that obtained with tungsten carbide, and at least four manufacturers are putting ceramic tools on the market. Lathes equipped with ceramic tools can machine steels at 1000 to 2000 surface fpm. However, the materials are so brittle that special tool holders must be used to support them, and it may be desirable to use them only for light finishing cuts, if the maximum speeds are used. At present speeds, they have advantages in that they require no coolants and can produce a smooth glossy finish somewhat similar to precision grinding.

In a new type of gyroscope, the balance is achieved through vibrating vanes rather than through conventional rotating units. One of the possible advantages of this type of gyroscope is that the inherent ruggedness and reliability may make it better for equipment which must stand shocks.

Recent developments show that metals in foil thicknesses can be successfully bonded to each other, or to thicker materials, by imposing ultrasonic vibrations on the zone to be welded. No heat is involved except that in dissipating the vibrating energy itself. The method can be used to join both similar and dissimilar metals. Without melting and with relatively little deformation of the pieces, the process will weld such materials as copper to aluminum, which is not now feasible, but important in the electrical field. It is believed that the motion which is induced breaks up the interface between the two metals, giving inter-molecular contact and thus making the weld. From this standpoint, the method resembles some of the cold pressure methods.

A new kink in welding is an anti-spatter compound consisting of a silicone emulsion which is wiped on to the metal area before welding. This invisible coat prevents molten spatter from sticking, and the operator merely has to take a cloth and wipe the spatter away after welding.

A new type of coagulant aid, a mixture of polyelectrolyte and bentonite clay, is being used in an automatic water clarification and demineralization system at Jones & Laughlin's tin plate department at Aliquippa. It saves about 30 per cent of the amount of alum coagulant previously used, and simplifies control of the clarifiers and of the sludge blanket in the clarifiers.

Armco Steel Corp. has developed a successful installation for the treatment of mill wastes from rolling mills at its Middletown, Ohio, plant. This unit has successfully removed heavy and fine mill scale, oil and grease from the waste since August, 1955. The first step involved treatment of waste waters from the roughing stands and the descaling sprays ahead of the finishing stands. After considerable study, a sedimentation basin was designed with mechanical collectors for the removal of scale and oil. In operation, the sedimentation basin removes approximately 145,000 lb of scale per day.

The treatment of waste from the finishing stands, carrying very fine scale, presented a different problem. Based on comprehensive test work carried on at the company's Butler plant, an installation was made including a pumping station with a sedimentation basin, effluent well and a clarified water well, a chemical mixing tank, two flocculation tanks, two clarifiers, and chemical storage and preparation facilities. Ferric sulphate is used as a coagulant and lime for pH adjustment. Heavy sludge is removed to rotary vacuum filters for drying. The average flow through the entire system during mill operations is at the rate of 11,500 gpm. Scale removal is at the rate of up to 206,000 lb per day. Approximately 200 gpm of river water are added to the system to take care of losses. It is reported that little difficulty has been experienced in the operation of this equipment, and maintenance has been at a minimum.

Steel plant engineers are using aerial photography to obtain maps of raw material stockpiles, and as a result, inventories can be made of such stockpiles at a relatively low cost. The technique is also valuable in studies for plant sites. It is claimed that aerial surveyors can estimate the tonnage in a stockpile within one-half per cent, compared with much larger percentages of error by the usual ground survey methods. One of the big advantages is that the inventory can be determined the instant that the aerial picture is taken, whereas the older ground surveys took fairly long periods of time.

ELECTRICAL

Outstanding to the electrical man in the year 1956 were the advances in control applications that render many continuous steel mill processes largely automatic. Application of electronics, of sensing elements and of signals from the sensing elements to set control gages, are radically changing the design of much equipment. Important in this development are related activities such as the development of mathematical computers, of reliable and better amplifiers, and of static switching elements. Not to be overlooked, however, is the greater use of electricity in steel as well as in all other industries. With every year that passes, estimates for future electrical energy requirements increase.

The electrical generating industry plans to double generating capacity within the next ten years and to quadruple capacity in the next twenty. At the present time it is spending at a rate of about $3,000,000,000 a year. About 8,000,000 kw of generating capacity was shipped in 1956. About 13,000,000 kw is scheduled for 1957 and over 9,000,000 kw has already been ordered for 1958. About 1,000,000 kw shipped in 1956 is hydraulic capacity, and similar equipment scheduled for 1957 is rated 1,700,000 kw, with another 1,100,000 kw in 1958. Thus, of the 30,000,000 kw for the three years, about 4,000,000 kw is hydraulic, a decline in the proportion of hydraulic capacity existing in 1955. Total generating capacity for electric utilities at the end of 1955 was about 128,000,000 kw. Total power consumption in 1956 was estimated at 680,000,000,000 kwhr compared with 623,000,000,000 kwhr in 1955. About 88 per cent was generated by utilities.

Static switching elements will be widely used in the steel industry on many control applications.

Main drive motors ranging from 500 to 3000 hp drive the new Weirton Steel, 5-stand, tandem, cold-reduction mill.

In 1956, with a steel production in the United States of about 115,000,000 ingot tons, the electrical energy used by the steel industry was about 35,000,000,000 kwhr, or about 310 kwhr ton of production. Use of electrical energy per ton of steel has a steady trend upward.

For all industries, it is estimated that the amount of electricity used per man-hour in 1956 was about 10 kwhr per manhour. This may go to 20 kwhr per manhour by 1956. This growth is a continuation of what has been happening since the war. In 1945 the figure was 4.74.

The first large steam turbo generator unit to use liquid cooled hollow stator conductors went into operation during the year at Cleveland Electric Illuminating Co's Eastlake, Ohio, power plant. By cooling the stator conductor bars with a liquid, an increase of 75 per cent kva output was obtained over conventionally cooled generators of similar size. The use of liquid coolant allows the bars to carry three times more current than present-day stators. Another feature of the generator is a gas-gap pickup method of cooling the generator motor. Small holes are cut at an angle in the rotor which scoop up hydrogen gas and force it into the hollow copper windings to give more effective cooling. Further development in this type of cooling is expected to double kva output for a given physical size.

Of the 35,000,000,000 kwhr of electrical energy consumed in 1956 by the steel industry, it is estimated that over half is in the form of direct current, hence, conversion equipment is important. As a result, attention is be-

ing centered on the conversion equipment. For low voltage, high current d-c applications (particularly under 125 volts), germanium rectifiers are finding favor because of high efficiency, long life and low maintenance. Two installations of germanium rectifiers were put in service in steel plants in 1955. One of these is on the electrolytic cleaning section of an annealing line in a large Canadian steel plant, the other on a section of a tinning line.

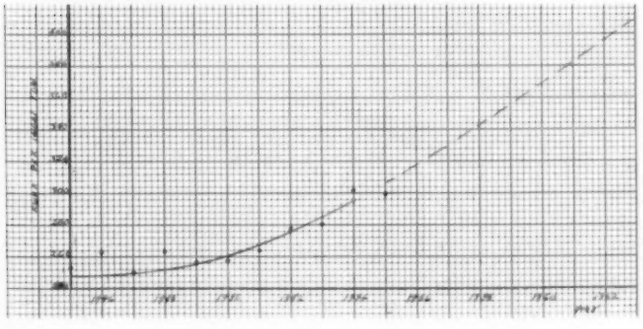
Improvements are constantly sought in mill drives to get higher production and better quality in the product. Most modern drives have such features as individual rectifiers, magnetic amplifier regulators, twin drives with individual armature loops, and individual motors on each table roll. Two hot strip mills under construction will have individual power supply for each finishing stand motor. This should give more flexible mill operation, since the stands can be run down to 60 per cent voltage, extending the available speed range. The biasing compensation of the individual voltage regulators gives responsive control to speed droop adjustment, etc. Possible d-c fault currents are greatly reduced, and there is a reduction in the number of line circuitb reakers, etc.

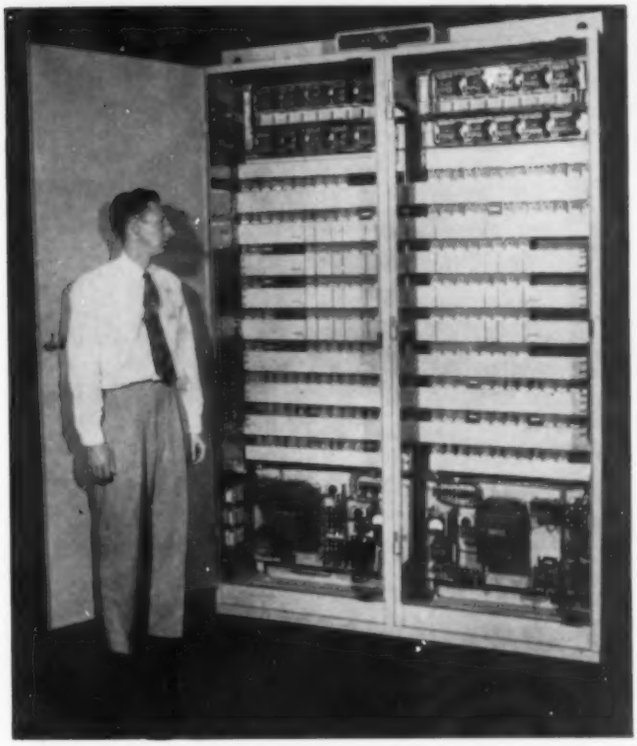
One of these mills is a 58-in. unit for a Pittsburgh district plant which is to roll silicon steel strip and stainless, other high alloy steels, and low carbon steel. Individual stand power supply is particularly advantageous for this wide range of product. This mill will have 5000-hp motors on the first three finishing stands, and 4000-hp motors on the last two stands. The last three stands will be direct-drive. The layout is such that a sixth finishing stand can be used. The roughing stand is a 36 and 58-in., 4-high, reversing universal mill. Work rolls are driven through pinions by a 7000-hp motor.

The other mill is a 56-in. unit being installed at a southern plant. It will consist of four 25 and 49-in. x 56-in. stands, each driven by a 3500-hp motor. This layout is set up to allow future addition of two more stands. An existing three-high universal mill will be used as a roughing mill ahead of this finishing train.

Wheeling Steel Co. contracted for the main drive and auxiliary electrical equipment for a five-stand, tandem cold reduction tin plate strip mill to be installed at Yorkville, Ohio. The mill will have a maximum delivery speed of 6000 fpm, and will be suitable for the production of cold reduced strip in widths of 18 to 42 in., in thicknesses of 0.00625 to 0.0359 in. Individual control for the generators supplying each mill stand and the reel drive will use 400-cycle magnetic amplifier systems for flexibility and precision. Installed motor hp for the five mill stands will total 21,000.

The use of electric power per ton in the steel industry is increasing markedly. Projection into the future provides some rather startling figures.





This static switching control system is on an automatic conveyor system which has 195 static control elements.

Three additional mill motors were added to the AISE mill motor standard and are now on the market. These motors in the 275, 375 and 500-hp, 1-hr ratings are applicable for many uses and represent logical extensions above the sizes formerly covered by AISE standards.

One motor manufacturer brought out a new line of d-c motors and generators designed to give versatility of application and performance. These units have speeds adjustable by armature voltage control, field strength control, or any combination of both. As a result, higher base speeds are available and higher top speeds may be obtained by field strength adjustment. They can operate at any speed below base, including stalled torque. Ratings and accessories are available from 1 to 150 hp or ¾ to 100 kw.

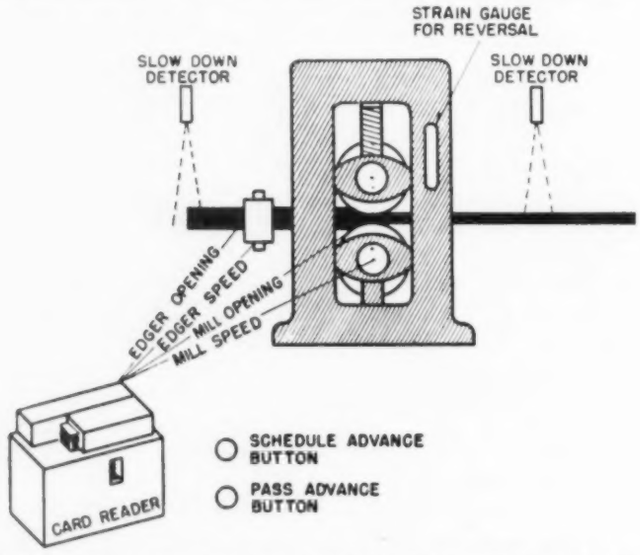
Another motor manufacturer announced a new synchronous motor available in ratings from ¼ to 40 hp. This unit is built on standard induction motor frames and enclosures. The motor requires no brushes, slip rings or windings on the rotor, separate source of d-c excitation or special starting equipment. It starts as an induction motor with a very high locked-rotor torque, accelerates and pulls into synchronism quickly, and runs as a synchronous motor. It has a high pull-out torque and remains in synchronism regardless of load or line voltage fluctuations. Frequencies of 300 cycles and speeds above 10,000 rpm are available, and at the other end of the range, the motors can be had with frequencies as low as 10 cycles. These motors need only standard across-the-line starting equipment, except in the very largest ratings, where reduced voltage starters are required.

A new differential voltage recorder indicates variations in roll speeds for rolling mills. Two instruments are available: one recorder has a scale and chart for direct reading of fpm draw, or stretch of steel; the other re-

corder measures and indicates the ratio between roll speeds. These instruments use a d-c tachometer geared to each of two rolls. Voltage difference of the two tachometers expresses any difference in roll speed. Simple adjustment of either tachometer circuit allows for difference in gearing and roll size. The recorders are unaffected by changes in operating speeds, recording only draw and ratio during speedups or slowdowns.

A special control device has cut maintenance cost on screwdown and side-guard drive motors and other mill equipment. A contactor drops a current limiting resistor in and out of the motor armature circuit automatically as required by actual current variation. This device is connected to the regular motor controller's accelerating resistance so that the contactor can operate at any time during starting acceleration or while the motor is operating across the line. The contactor is adjustable so that it can be set to limit motor armature current to practically any desired value. This feature makes it ideal for application to almost any heavy duty motor-driven equipment which is subject to jamming or stalling during operation, such as coke pushers, stripping cranes, conveyor systems, and skip hoists, as well as rolling mill auxiliaries. The device may be applied to d-c series, shunt or compound-wound motors.

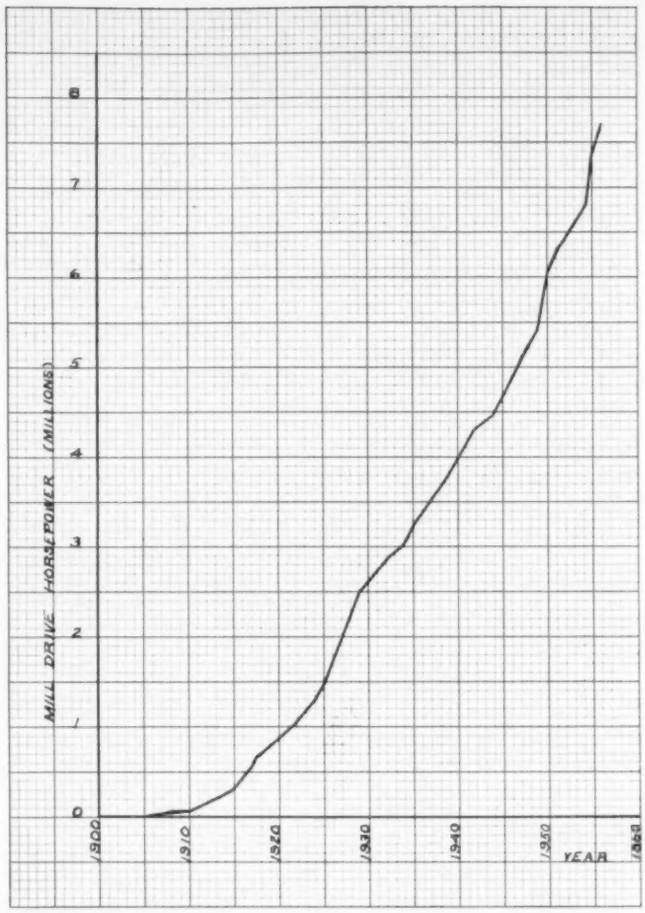
Several recent rod mill drives have a new type of speed matching system which uses motors of standard



The new rougher on the new hot strip mill at J & L's Aliquippa works is equipped for automatic operation.

impact speed drop characteristics and speed regulators for each drive. The system is designed to hold steady speed within 0.25 percent from no load to full load, and has improved response time over previous systems. The speed regulator compares the feedback voltage of a tachometer generator driven by the main drive motor with the reference voltage. The result is amplified by magnetic amplifiers connected in and applied to the control fields of a rotating amplifier connected in series with the motor shunt field. Advantages are faster recovery from impact loads, improved speed regulation, light weight, and easily operated manual vernier (rheostats) and fast response to vernier adjustments.

Static switching control is a method of electrically controlling machine functions by the use of logic elements and accessories which are not subject to wear and



Accumulative curve of main drive motors over 300 hp shows a total as of January 1, 1957, of 7,679,014 hp. Two hundred and fifty-four motors (474,860 hp), were added in 1956, of which 226 were d-c and 28 were a-c.

erosion. Static control logic elements in the heart of the system convert combinations of inputs into a single output by controlling the impedance of an output coil on a magnetic coil.

All of these elements have the same physical shape and exterior appearance and are identified by name plate. A typical element size is about 1½ in. wide, 4¼ in. high and 2 in. deep. Internal parts are cores made of square loop material, spool-wound coils, germanium rectifiers, resistors and capacitors. These are all packed in a special material which eliminates magnetic distortion of the cores, and offers protection against mechanical shock and vibration.

Power supply for the elements is packaged in a metal enclosure. In addition to the logic elements and power supplies, power amplifiers are necessary to raise the output of the elements to the required power level. Several amplifiers may be connected to a single power supply but it is sometimes necessary to use more than one power supply if many amplifiers are required. Amplifiers and their power supplies are available in several power ratings.

The logic units and their associated supplies and output amplifiers provide a new tool for performing a wide range of applications in control of machines, processing lines, etc. New switching control can be furnished in component form or in completely engineered systems, so designed as to permit it to be combined with the

(Please turn to page 169)

ELECTRIC MOTOR DRIVES THREE HUNDRED HORSEPOWER AND OVER

APPLIED TO ROLLING MILLS IN THE IRON AND STEEL AND ALLIED INDUSTRIES DURING 1956

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
1	300	150/600	350	d-c	Direct	56-In. Single stand temper mill entry reel	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
2	300	150/600	350	d-c	Direct	56-In. Single stand temper mill entry reel	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
3	300	500/1000	250	d-c	Direct	Aluminum foil mill—main stand	Reynolds Metals Co.	Louisville, Ky.	Allis-Chalmers
4	300	500/1000	250	d-c	Direct	Aluminum foil mill—main stand	Reynolds Metals Co.	Louisville, Ky.	Allis-Chalmers
5	300	375/900	230	d-c	Geared	98-in. Hot strip mill coiler	Republic Steel Corp.	Cleveland, Ohio	General Electric
6	300	300/900	600	d-c	Geared	16 Stand, 11-in. merchant mill, stand No. 1	Republic Steel Corp.	Chicago, Ill.	General Electric
7	300	300/900	600	d-c	Geared	16 Stand, 11-In. merchant mill, stand No. 2	Republic Steel Corp.	Chicago, Ill.	General Electric
8	300	250/1000	600	d-c	Direct	19 x 53 x 48-in., 2-stand temper mill uncoiler	Tennessee Coal & Iron Div., U.S. Steel Corp.	Fairfield, Ala.	General Electric
9	300	250/1000	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill uncoiler	Tennessee Coal & Iron Div., U.S. Steel Corp.	Fairfield, Ala.	General Electric
10	300	575/1150	250	d-c	Direct	50-In., 2-high, single stand, non-rev., skin pass mill	Eastern Stainless Steel Corp.	Baltimore, Md.	Reliance Electric & Engineering
11	300	450/1200	230	d-c	Direct	36-In., 4-high, single stand	Canada Foils, Ltd.	Canada	Reliance Electric & Engineering
12	300	300/900	600	d-c	Geared	22-In. Reversing mill	Westinghouse	Pittsburgh, Pa.	Westinghouse
13	300	500/1000	230	d-c	Geared	Scalebreaker	Hojalata Y Lamina	Monterrey, Mexico	Westinghouse
14	300	500/1000	230	d-c	Geared	Scalebreaker	Hojalata Y Lamina	Monterrey, Mexico	Westinghouse
15	300	300/750	700	d-c	Geared	No. 6A Edger stand structural mill	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
16	300	400/1200	200	d-c	Geared	Reel	Stanley Works	New Britain, Conn.	Elliott
17	300	400/1200	200	d-c	Geared	Reel	Stanley Works	New Britain, Conn.	Elliott
18	350	400/1120	250	d-c	Direct	Aluminum foil mill, main stand	Reynolds Metals Co.	Louisville, Ky.	Allis-Chalmers
19	350	500/1500	250	d-c	Direct	50-In., 4-high, 1-stand, foil mill	Blaw-Knox Co.	Austria Export	Reliance Electric & Engineering
20	350	500/1500	250	d-c	Direct	50-In., 4-high, 1-stand, foil mill	Blaw-Knox Co.	Austria Export	Reliance Electric & Engineering
21	350	575/1650	250	d-c	Direct	60-In., 4-high, 1-stand, foil mill	Cochran Foil Co.	Louisville, Ky.	Reliance Electric & Engineering
22	350	575/1650	250	d-c	Direct	60-In., 4-high, 1-stand, foil mill	Cochran Foil Co.	Louisville, Ky.	Reliance Electric & Engineering
23	350	400/800	550	d-c	Geared	No. 2 Edger	Armco	Middletown, Ohio	Westinghouse
24	350	450/900	250	d-c	Geared	56-In. single stand temper mill, exit puller	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
25	①350	400/600	250	d-c	Direct	56-In., single stand temper mill, main stand	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
26	①350	400/600	250	d-c	Direct	56-In., single stand temper mill, main stand	Steel Co. of Canada	Hamilton, Ontario Canada	General Electric
27	350	300/600	230	d-c	Direct	Reversing cold strip mill, main stand	Atlas Steels	Welland, Ontario, Canada	General Electric
28	①350	290/975	250	d-c	Geared	56-In., single stand temper mill, uncoiler	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
29	①350	290/975	250	d-c	Geared	56-In., single stand temper mill, uncoiler	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
30	①350	290/975	250	d-c	Geared	56-In., single stand temper mill, recoiler	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
31	①350	290/975	250	d-c	Geared	56-In., single stand temper mill, recoiler	Steel Co. of Canada	Hamilton, Ontario, Canada	General Electric
32	350	225/1040	600	d-c	Direct	2-Stand, 4-high, temper mill winding reel	Breedband, N.V.	Netherlands	General Electric
33	350	225/1040	600	d-c	Direct	2-Stand, 4-high temper mill, payoff reel	Breedband, N.V.	Netherlands	General Electric
34	375	360/1080	250	d-c	Geared	Hot strip mill coiler	Inland Steel Co.	East Chicago, Ind.	General Electric
35	375/750	360/720	230/460	d-c	Geared	Reversing cold mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Westinghouse
36	375/750	360/720	230/460	d-c	Geared	Reversing cold mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Westinghouse
37	②400	690/1000	600	d-c	Direct	2-Stand, 4-high temper mill delivery tension	Breedband, N.V.	Netherlands	General Electric
38	②400	690/1000	600	d-c	Direct	2-Stand, 4-high, temper entry tension	Breedband, N.V.	Netherlands	General Electric
39	400	690/850	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill entry bridle	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
40	①400	690/850	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill delivery bridle	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
41	①400	690/850	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill delivery bridle	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
42	①400	1150/1437	250	d-c	Geared	Taper disc rolling mill	Kelsey-Hayes Wheel Co.	McKeesport, Pa.	Reliance Electric & Engineering
43	①400	1150/1437	250	d-c	Geared	Taper disc rolling mill	Kelsey-Hayes Wheel Co.	McKeesport Pa.	Reliance Electric & Engineering
44	400	300/900	600	d-c	Geared	42-In., bright strip mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Westinghouse
45	400	300/1200	250	d-c	Geared	Sendzimir mill	Scovill Mfg. Co.	Waterbury, Conn.	Westinghouse
46	400	300/1200	250	d-c	Geared	Sendzimir mill	Scovill Mfg. Co.	Waterbury, Conn.	Westinghouse
47	400	400/1200	250	d-c	Geared	Aluminum hot slab mill tension reel	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
48	+400	900	2300	60	Geared	16-In. rail slitting mill roughing stand	Jersey Shore Steel Co.	Jersey Shore, Pa.	Elliott
49	400(300kw)	300/1050	600	d-c	Geared	2-Stand aluminum cold mill payoff reel	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
50	400(300kw)	400/1200	200/400	d-c	Geared	1-Stand aluminum cold mill payoff reel	American Brass Co.	Terre Haute, Ind.	Westinghouse
51	450	450/1350	250	d-c	Geared	62-In., 4-high, 1-stand foil mill	Johnson Mfg. Co.	St. Louis, Mo.	Reliance Electric & Engineering
52	450	450/1350	250	d-c	Geared	60-In., 4-high, 1-stand foil mill	Cochran Foil Co.	Louisville, Ky.	Reliance Electric & Engineering
53	500	350/1050	250	d-c	Direct	Aluminum foil mill, main stand	Reynolds Metals Co.	Louisville, Ky.	Allis-Chalmers
54	①②500	850/1150	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill, stand 1	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
55	①②500	850/1150	600	d-c	Direct	19 x 53 x 48-In., 2-stand temper mill, stand 1	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
56	500	500/1000	600	d-c	Geared	56-In., 2-high temper mill, main stand	Inland Steel Co.	East Chicago, Ind.	General Electric
57	500	500/1000	600	d-c	Geared	56-In., 2-high temper mill, main stand	Inland Steel Co.	East Chicago, Ind.	General Electric
58	500	350/1040	600	d-c	Geared	16-Stand, 11-in., merchant mill, stand 3	Republic Steel Corp.	South Chicago, Ill.	General Electric
59	500	350/1040	600	d-c	Geared	16-Stand, 11-in., merchant mill, stand 4	Republic Steel Corp.	South Chicago, Ill.	General Electric
60	500	350/1040	600	d-c	Geared	16-Stand, 11-in., merchant mill, stand 5	Republic Steel Corp.	South Chicago Ill.	General Electric
61	500	300/600	600	d-c	Direct	Non-reversing aluminum foil intermediate mill reel	Ekco-Alcoa	Wheeling, W. Va.	General Electric
62	500	250/1060	600	d-c	Geared	50-In. sendzimir mill reel	Allegheny-Ludlum Steel Corp.	Brackenridge, Pa.	General Electric
63	500	250/1060	600	d-c	Geared	50-In. sendzimir mill reel	Allegheny-Ludlum Steel Corp.	Brackenridge, Pa.	General Electric
64	500	250/1060	600	d-c	Geared	50-In. sendzimir mill reel	Allegheny-Ludlum Steel Corp.	Brackenridge, Pa.	General Electric
65	500	250/1060	600	d-c	Geared	50-In. sendzimir mill reel	Allegheny-Ludlum Steel Corp.	Brackenridge, Pa.	General Electric

ELECTRIC MOTOR DRIVES THREE HUNDRED HORSEPOWER AND OVER

(CONTINUED)

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
66	500	400/1000	600	d-c	Direct	56-In., 4-high, 1-stand, aluminum mill	Reynolds Tobacco Co.	Winston Salem, N. C.	Reliance Electric & Engineering
67	500	850/1500	600	d-c	Direct	62-In. foil mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Westinghouse
68	500	350/1200	120/480	d-c	Geared	Aluminum, 1-stand cold mill tension reel	American Brass Co.	Terre Haute, Ind.	Westinghouse
69	500	400/800	550	d-c	Geared	No. 1 Edger	Armco	Middletown, Ohio	Westinghouse
70	500	400/1050	250	d-c	Geared	4-High reversing mill	Union Carbide Nuclear Co.	Oak Ridge, Tenn.	Elliott
71	535(400kw)	300/1050	200/900	d-c	Geared	2-Stand aluminum cold mill payoff reel	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
72	600	575/1150	600	d-c	Geared	36-In., 4-high non-reversing brass mill	American Brass Co.	Paramount, Calif.	Allis-Chalmers
73	600	400/1200	400	d-c	Geared	Reel	Stanley Works	New Britian, Conn.	Elliott
74	600	400/1200	400	d-c	Geared	Reel	Stanley Works	New Britian, Conn.	Elliott
75	600	575/1070	600	d-c	Drive	2-Stand, 4-high temper mill, stand 1	Breedband N. V.	Netherlands	General Electric
76	600	350/980	600	d-c	Drive	16-Stand, 11-in., merchant mill, stand 12	Republic Steel Corp.	South Chicago, Ill.	General Electric
77	600	350/980	600	d-c	Drive	16-Stand, 11-in. merchant mill, stand 10	Republic Steel Corp.	South Chicago, Ill.	General Electric
78	②600	300/1100	600	d-c	Geared	26-In. sendzimir mill reel	Wallingford Steel Co.	Wallingford, Conn.	General Electric
79	②600	300/1100	600	d-c	Geared	26-In. sendzimir mill reel	Wallingford Steel Co.	Wallingford, Conn.	General Electric
80	600	250/1000	600	d-c	Drive	19 x 53 x 48-In., 2-stand temper mill	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
81	600	250/750	600	d-c	Drive	16-Stand, 11-in., merchant mill, stand 6	Republic Steel Corp.	South Chicago, Ill.	General Electric
82	600	250/750	600	d-c	Geared	16-Stand, 11-in., merchant mill, stand 7	Republic Steel Corp.	South Chicago, Ill.	General Electric
83	600	350/875	600	d-c	Direct	56-In., 4-high, 1-stand aluminum foil mill	Reynolds Tobacco Co.	Winston Salem, N. C.	Reliance Electric & Engineering
84	600	850/1080	600	d-c	Direct	Tube mill	Wolverine Tube Co.	Detroit, Mich.	Reliance Electric & Engineering
85	600	225/375	600	d-c	Direct	2-Stand temper mill	Kaiser Steel Corp.	Fontana, Calif.	Westinghouse
86	600	400/500	600	d-c	Direct	2-Stand temper mill	Kaiser Steel Corp.	Fontana, Calif.	Westinghouse
87	600	300/1050	600	d-c	Geared	Aluminum 2-stand cold mill tension reel	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
88	600	300/1050	200/400	d-c	Geared	Aluminum 1-stand cold mill tension reel	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
89	①②700	850/1150	600	d-c	Direct	19 x 53 x 48-In., 2-stand, temper mill, stand 1	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
90	①②700	850/1150	600	d-c	Direct	19 x 53 x 48-In. 2-stand, temper mill, stand 2	Tennessee Coal & Iron Div., U. S. Steel Corp.	Fairfield, Ala.	General Electric
91	700	690/1270	600	d-c	Geared	26-In. sendzimir mill	Wallingford Steel Co.	Wallingford, Conn.	General Electric
92	700	350/1000	600	d-c	Direct	16-Stand, 11 in., merchant mill, stand 15	Republic Steel Corp.	South Chicago, Ill.	General Electric
93	700	350/750	600	d-c	Direct	16-Stand, 11-in., merchant mill, stand 13	Republic Steel Corp.	South Chicago, Ill.	General Electric
94	700	200/800	600	d-c	Geared	Sendzimir mill reel	Armco	Butler, Pa.	Westinghouse
95	700	200/800	600	d-c	Geared	Sendzimir mill reel	Armco	Butler, Pa.	Westinghouse
96	700	200/800	600	d-c	Geared	Sendzimir mill reel	Armco	Butler, Pa.	Westinghouse
97	700	200/800	600	d-c	Geared	Sendzimir mill reel	Armco	Butler, Pa.	Westinghouse
98	700	200/800	600	d-c	Geared	42-In., reversing cold strip mill reel	Armco	Butler, Pa.	Westinghouse
99	700	200/800	600	d-c	Geared	42-In., reversing cold strip mill reel	Armco	Butler, Pa.	Westinghouse
100	700	200/800	600	d-c	Geared	42-In., reversing cold strip mill reel	Armco	Butler, Pa.	Westinghouse
101	700	200/800	600	d-c	Geared	42-In., reversing cold strip mill reel	Armco	Butler, Pa.	Westinghouse
102	750	250/875	600	d-c	Geared	Reversing cold mill reel	Hojalata Y Lamina	Monterrey, Mex.	Westinghouse
103	750	250/875	600	d-c	Geared	Reversing cold mill reel	Hojalata Y Lamina	Monterrey, Mex.	Westinghouse
104	750	1200	4000	60	Geared	10 In. merchant mill	Empressa Siderurgica	Medellin, Columbia	Westinghouse
105	800	900	2300	60	Geared	12-In. mill finishing train	Jersey Shore Steel Co.	Jersey Shore, Pa.	Elliott
106	800	900	2300	60	Geared	Tube stretch mill	Lone Star Steel Co.	Lone Star, Texas	General Electric
107	②800	690/1380	500	d-c	Direct	72-In. non reversing aluminum foil mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	General Electric
108	*800	514	6900	60	Geared	Rod mill	Kaiser Aluminum & Chemical Corp.	Newark, N. J.	General Electric
109	800	400/970	600	d-c	Geared	1-Stand, 16-in., reversing cold mill	Signode Steel Strapping Co.	Weirton, W. Va.	General Electric
110	800	350/965	600	d-c	Direct	16-Stand,11-in., merchant mill, stand 11	Republic Steel Corp.	South Chicago, Ill.	General Electric
111	800	350/965	600	d-c	Direct	16-Stand, 11-in. merchant mill, stand 14	Republic Steel Corp.	South Chicago, Ill.	General Electric
112	800	350/965	600	d-c	Direct	16-Stand, 11-in., merchant mill, stand 16	Republic Steel Corp.	South Chicago, Ill.	General Electric
113	800	350/900	600	d-c	Geared	16-Stand, 11-in., merchant mill stand 8	Republic Steel Corp.	South Chicago, Ill.	General Electric
114	800	350/900	600	d-c	Geared	16 Stand, 11 in., merchant mill, stand 9	Republic Steel Corp.	South Chicago, Ill.	General Electric
115	900	575/1070	600	d-c	Direct	2-Stand, 4-high temper mill winding reel, stand 2	Breedband, N. V.	Netherlands	General Electric
116	900	450/1110	600	d-c	Geared	56-In., 4-high, 1-stand, aluminum foil mill	Reynolds Tobacco Co.	Winston Salem, N. C.	Reliance Electric & Engineering
117	1000	400/800	600	d-c	Geared	20-In. billet mill	Copperweld Steel Co.	Warren, Ohio	Allis Chalmers
118	1000	400/800	600	d-c	Geared	20-In. billet mill	Copperweld Steel Co.	Warren, Ohio	Allis Chalmers
119	1000	400/800	600	d-c	Geared	20-In. billet mill	Copperweld Steel Co.	Warren, Ohio	Allis-Chalmers
120	1000	400/800	600	d-c	Geared	20-In. billet mill	Copperweld Steel Co.	Warren, Ohio	Allis-Chalmers
121	1000	600/1200	600	d-c	Geared	Aluminum foil mill	Aluminum Co. of Canada	Kingston, Ontario, Canada	General Electric
122	*1000	900	4160	60	Geared	4-High non-reversing cold mill breakdown stand	Riverside Metals Co.	Riverside, N. J.	General Electric
123	1000/1000	450/720	2300	60	Direct	12-In. and 10-in., merchant mill	Vanadium Alloys Steel Co.	Latrobe, Pa.	General Electric
124	1000	300/750	700	d-c	Geared	Sheet bar and billet mill, finishing train stand F2 vertical	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
125	1000	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F4 vertical	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
126	1000	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train Stand F7, vertical	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
127	1000	150/560	600	d-c	Direct	50-In. sendzimir	Allegheny Ludlum Steel Corp.	Brackenridge, Pa.	General Electric
128	†1000	514	2300	60	Geared	Bar mill	Vanadium Alloys Steel Co.	Latrobe, Pa.	Westinghouse
129	1000	575/1150	600	d-c	Geared	Aluminum 1-stand cold mill	American Brass Co.	Terre Haute, Ind.	Westinghouse
130	1000	150/500	600	d-c	Geared	Cold mill reel	Armco	Middletown, Ohio	Westinghouse
131	1000	400/800	600	d-c	Geared	Cold mill, No 1 stand	Armco	Butler, Pa.	Westinghouse
132	1000	400/800	600	d-c	Geared	Cold mill, No. 2 stand	Armco	Butler, Pa.	Westinghouse
133	1000	400/800	600	d-c	Geared	Cold mill, No. 3 stand	Armco	Butler, Pa.	Westinghouse
134	1000	150/500	600	d-c	Geared	Cold mill reel	Armco	Butler, Pa.	Westinghouse
135	②1200	200/700	750	d-c	Direct	56-In. 4-stand tandem cold strip mill tension reel	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
136	②1200	175/612	600	d-c	Direct	56-In., 2-high temper mill reel	Inland Steel Co.	East Chicago, Ind.	General Electric
137	②1200	175/612	600	d-c	Direct	56-In., 4-stand tandem cold mill reel	Inland Steel Co.	East Chicago, Ind.	General Electric
138	1250	600	2300	60	Geared	Skin pass mill	Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Westinghouse
139	1250	400/1000	600	d-c	Direct	Sendzimir mill	Scovill Mfg. Co.	Waterbury, Conn.	Westinghouse
140	1400	225	600	d-c	Direct	50-In. sendzimir cold strip mill tension reel	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
141	1400	675	600	d-c	Direct	50-In. sendzimir cold strip mill tension reel	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
142	1500	225/400	600	d-c	Direct	50-In. sendzimir cold strip mill	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
143	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-1, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
144	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-3, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
145	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-5, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
146	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-6, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
147	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-8, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
148	1500	300/750	700	d-c	Geared	Sheet bar and billet mill finishing train stand F-9, horizontal	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
149	1500	110/275	750	d-c	Direct	53-In. x 34-in. structural mill No. 1 edger	United States Steel Corp.	South Works Chicago, Ill.	General Electric
150	1500	110/275	750	d-c	Direct	53-In. x 34-in. structural mill No. 2 edger	United States Steel Corp.	South Works Chicago, Ill.	General Electric
151	1500	110/275	750	d-c	Direct	53-In. x 34-in. structural mill No. 3 edger	United States Steel Corp.	South Works Chicago, Ill.	General Electric
152	1500	250/500	600	d-c	Geared	96-In. Aluminum slabbing mill	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
153	1500	300/750	700	d-c	Geared	Structural mill, No. 1 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
154	1500	300/750	700	d-c	Geared	Structural mill, No. 2 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
155	1500	300/750	700	d-c	Geared	Structural mill, No. 3 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
156	1500	300/750	700	d-c	Geared	Structural mill, No. 4 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
157	1500	300/750	700	d-c	Geared	Structural mill, No. 5 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
158	1500	300/750	700	d-c	Geared	Structural mill, No. 6 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
159	1500	300/750	700	d-c	Geared	Structural mill, No. 7 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
160	1500	300/750	700	d-c	Geared	Structural mill, No. 8 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
161	1500	300/750	700	d-c	Geared	Strudtural mill, No. 9 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
162	1500	300/750	700	d-c	Geared	Structural mill, No. 10 stand	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
163	1750	450/850	600	d-c	Geared	Sendzimir cold reversing mill	Stanley Works	New Britain, Conn.	Elliott
164	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 1	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
165	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 2	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
166	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 3	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
167	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 4	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
168	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 5	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
169	1750	300/600	700	d-c	Geared	30-In., 6-stand billet mill, stand 6	Pittsburgh Steel Co.	Monessen, Pa.	General Electric
170	1750	225/400	750	d-c	Direct	Sendzimir mill	Armco	Butler, Pa.	Westinghouse
171	1750	225/393	700	d-c	Direct	Sendzimir mill	Jones & Laughlin Steel Corp.	Cleveland, Ohio	Westinghouse
172	1750	225/620	700	d-c	Geared	Sendzimir mill reel	Jones & Laughlin Steel Corp.	Cleveland, Ohio	Westinghouse
173	1750	225/620	700	d-c	Geared	Sendzimir mill reel	Jones & Laughlin Steel Corp.	Cleveland, Ohio	Westinghouse
174	1750	230/460	600	d-c	Geared	Reversing cold mill	Hojalata Y Lamina	Monterrey, Mexico	Westinghouse
175	2000	250/625	600	d-c	Geared	21 x 53 x 60-In. hot strip mill	American Brass Co.	Terre Haute, Ind.	General Electric
176	2000	250/625	600	d-c	Geared	21 x 53 x 60-In. hot strip mill	American Brass Co.	Terre Haute, Ind.	General Electric
177	2000	60/150	700	d-c	Geared	Universal slabbing mill	United States Steel Corp.	Gary, Ind.	Westinghouse
178	2000	60/150	700	d-c	Geared	Universal slabbing mill	United States Steel Corp.	Gary, Ind.	Westinghouse
179	2250	300/660	600	d-c	Geared	23 x 49 x 66-In., 2-stand tandem cold mill, stand 1	Reynolds Metals Co.	Listerhill, Ala.	General Electric
180	2250	300/660	600	d-c	Geared	23 x 49 x 66-In., 2-stand tandem cold mill, stand 2	Reynolds Metals Co.	Listerhill, Ala.	General Electric
181	④2500	225/450	750	d-c	Direct	56-In., four-stand, tandem cold strip mill, stand 2	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
182	④2500	300/570	750	d-c	Direct	56-In., four-stand, tandem cold strip mill, stand 3	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
183	2500	250/500	600	d-c	Geared	Aluminum hot slabbing mill, stand 1	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
184	2500	250/500	600	d-c	Geared	Aluminum hot slabbing mill, stand 2	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
185	2500	250/500	600	d-c	Geared	Aluminum 2-stand cold mill, stand 1	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
186	2500	250/500	600	d-c	Geared	Aluminum 2-stand cold mill, stand 2	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
187	2500	400/800	600	d-c	Geared	Aluminum 1-stand cold mill	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
188	②3000	100/300	600	d-c	Geared	56-In., 4-stand tandem cold mill stand 1	Inland Steel Co.	East Chicago, Ind.	General Electric
189	3000	80/160	750	d-c	Direct	53-In. x 34-in. structural mill, stand 4	United States Steel Corp.	South Works Chicago, Ill.	General Electric
190	①④3000	40/80	700	d-c	Direct	Blooming mill	United States Steel Corp.	South Works Chicago, Ill.	Westtinghouse
191	①④3000	40/80	700	d-c	Direct	Blooming mill	United States Steel Corp.	South Works Chicago, Ill.	Westinghouse
192	①④3000	40/80	700	d-c	Direct	Blooming mill	United States Steel Corp.	South Works Chicago, Ill.	Westinghouse
193	①④3000	40/80	700	d-c	Direct	Blooming mill	United States Steel Corp.	South Works Chicago, Ill.	Westinghouse
194	①④3000	40/80	700	d-c	Direct	Universal slabbing mill	United States Steel Corp.	Gary, Ind.	Westinghouse
195	①④3000	40/80	700	d-c	Direct	Universal slabbing mill	United Srates Steel Corp.	Gary, Ind.	Westinghouse
196	①④3000	40/80	700	d-c	Direct	Universal slabbing mill	United States Steel Corp.	Gary, Ind.	Westinghouse
197	①④3000	40/80	700	d-c	Direct	Universal slabbing mill	United States Steel Corp.	Gary, Ind.	Westinghouse
198	①3000	40/80	700	d-c	Direct	38 x 96-In. blooming mill	Altos Hornos	Montclova, Mexico	Westinghouse
199	①3000	40/80	700	d-c	Direct	38 x 96-In. blooming mill	Altos Hornos	Montclova, Mexico	Westinghouse
200	3000	60/150	700	d-c	Direct	28-In. blooming mill	Bethlehem Steel Co.	Steelton, Pa.	Westinghouse
201	*3000	514	6600	60	Geared	Finishing stand	Bethlehem Steel Co.	Steelton, Pa.	Westinghouse
202	*3000	150	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
203	3500	30/60	750	d-c	Direct	54-In., hot strip mill, No. 1 Finisher F1	Detroit Steel Corp.	Portsmouth, Ohio	General Electric
204	①3500	30/60	600	d-c	Direct	170-In. aluminum slabbing mill	Reynolds Metals Co.	Listerhill, Ala.	Westinghouse
205	3500	30/60	600	d-c	Direct	170-In. aluminum slabbing mill	Reynolds Metals Co.	Listerhill, Ala.	Westinghouse
206	3500	60/150	750	d-c	Direct	28 x 72-In. reversing mill	Tata Iron & Steel Co.	Jamshedpur, India	Westinghouse
207	+4000	94.7	6600	60	Direct	Billet mill	Dominion Iron & Steel, Ltd.	Sidney, Nova Scotia Canada	General Electric
208	①4000	80/160	750	d-c	Direct	53-In. x 34-in. structural mill, stand 1	United States Steel Corp.	South Works Chicago, Ill.	General Electric
209	①4000	80/160	750	d-c	Direct	53-In. x 34-in. structural mill, stand 1	United States Steel Corp.	South Works Chicago, Ill.	General Electric
210	4000	60/160	750	d-c	Direct	53 In. x 34-in. structural mill, stand 3	United States Steel Corp.	South Works Chicago, Ill.	General Electric
211	4000	70/1750	600	d-c	Direct	4-High reversing hot strip mill	Cia Pacifico	Chile	General Electric
212	②4000	60/150	750	d-c	Direct	45-In. x 90-in. slabbing mill edger	Bethlehem Steel Co.	Sparrows Point, Md.	General Electric
213	②4000	60/150	750	d-c	Direct	45-In. x 90-in. slabbing mill edger	Inland Steel Co.	East Chicago, Ind.	General Electric
214	①4000	60/120	750	d-c	Direct	53-In. x 34-in. structural mill breakdown stand	United States Steel Corp.	South Works Chicago, Ill.	General Electric
215	①4000	60/120	750	d-c	Direct	53-In. x 34-in. structural mill breakdown stand	United States Steel Corp.	South Works Chicago, Ill.	General Electric
216	①4000	40/120	700	d-c	Direct	40-In. blooming mill	United States Steel Corp.	Clairton, Pa.	General Electric
217	①4000	40/120	700	d-c	Direct	40-In. blooming mill	United States Steel Corp.	Clairton, Pa.	General Electric
218	4000	30/60	600	d-c	Direct	30 x 56 x 96-in. reversing slabbing mill	American Brass Co.	Terre Haute, Ind.	General Electric
219	②4000	60/150	700	d-c	Geared	Slabbing mill	Kaiser Steel Corp.	Fontana, Calif.	Westinghouse
220	4000	150/335	700	d-c	Direct	Cold mill, stand 3	Armco	Middletown, Ohio	Westinghouse
221	+5000	514	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
222	③5000	350/725	750	d-c	Direct	56-In., 4-stand tandem cold strip mill, stand 4	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
223	5000	514	6600	60	Geared	No. 2 Rougher	United States Steel Corp.	Gary Sheet & Tin, Gary Ind.	General Electric
224	5000	300	6600	25	Geared	76-In., hot strip rougher, stand 3	Inland Steel Co.	East Chicago, Ind.	General Electric
225	②5000	150/425	600	d-c	Geared	56-In., 4-stand tandem cold mill, stand 2	Inland Steel Co.	East Chicago, Ind.	General Electric
226	①5000	50/100	750	d-c	Direct	46-In., reversing blooming mill	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
227	①5000	50/100	750	d-c	Direct	46-In. reversing blooming mill	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
228	①5000	40/80	750	d-c	Direct	46 x 100-In. reversing blooming mill	Steel Co. of Canada, Ltd.	Hamilton, Ontario, Canada	General Electric
229	①5000	40/80	750	d-c	Direct	46 x 100-In. reversing blooming mill	Steel Co. of Canada, Ltd.	Hamilton, Ontario, Canada	General Electric
230	①⑥5000	40/100	700	d-c	Direct	Slabbing mill	Kaiser Steel Corp.	Fontana, Calif.	Westinghouse
231	5000	35/70	600	d-c	Direct	96-In. aluminum slabbing mill	Olin-Mathieson Chemical Co.	Clarington, Ohio	Westinghouse
232	5000	50/120	700	d-c	Direct	Rougher	Empire Steel Co.	Mansfield, Ohio	Westinghouse
233	②5500	250/490	750	d-c	Direct	42-In., reversing cold strip mill	Armco	Butler, Pa.	Westinghouse
234	5750	375	6600	25	Geared	76-In., hot strip mill rougher, stand 4	Inland Steel Company	East Chicago, Ind.	General Electric
235	*6000	514	11,000	60	Geared	98-In., hot strip mill	Republic Steel Corp.	Cleveland, Ohio	Allis-Chalmers
236	*6000	514	11,000	60	Geared	98-In., hot strip mill	Republic Steel Corp.	Cleveland, Ohio	Allis-Chalmers
237	*6000	514	11,000	60	Geared	98-In., hot strip mill	Republic Steel Corp.	Cleveland, Ohio	Allis-Chalmers
238	*6000	514	11,000	60	Geared	98-In., hot strip mill	Republic Steel Corp.	Cleveland, Ohio	Allis-Chalmers
239	*6000	240	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
240	*6000	360	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
241	*6000	360	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
242	*6000	360	6900	60	Geared	86-In., hot strip mill	Kaiser Steel Corp.	Fontana, Calif.	Allis-Chalmers
243	*6000	240	13,800	60	Geared	42–32-In. billet mill	Steel Div. Ford Motor Co	Dearborn, Mich.	Elliott
244	③6000	250/625	600	d-c	Geared	56-In., 4-stand tandem cold mill, stand 3	Inland Steel Co.	East Chicago, Ind.	General Electric

ELECTRIC MOTOR DRIVES THREE HUNDRED HORSEPOWER AND OVER

(CONTINUED)

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
245	⑥6000	250/625	600	d-c	Geared	56-In., 4-stand tandem cold mill, stand 4	Inland Steel Co.	East Chicago, Ind.	General Electric
246	⑥6000	80/160	750	d-c	Direct	Structural mill, stand 2	United States Steel Corp.	South Chicago, Ill.	General Electric
247	6000	80/160	750	d-c	Direct	Sheet bar and billet mill rougher	Tata Iron & Steel Co.	Jamshedpur, India	General Electric
248	①②6000	40/80	750	d-c	Direct	45 x 90-In. slabbing mill	Inland Steel Co.	East Chicago, Ind.	General Electric
249	①②6000	40/80	750	d-c	Direct	45 x 90-In. slabbing mill	Inland Steel Co.	East Chicago, Ind.	General Electric
250	①③6000	40/80	750	d-c	Direct	45 x 90-In. slabbing mill	Bethlehem Steel Co.	Sparrows Point, Md.	General Electric
251	①③6000	40/80	750	d-c	Direct	45 x 90-In. slabbing mill	Bethlehem Steel Co.	Sparrows Point, Md.	General Electric
252	*6000	600	6600	60	Geared	Roughing mill, stand 3	Armco	Middletown, Ohio	Westinghouse
253	*6000	600	6600	60	Geared	Roughing mill, stand 4	Armco	Middletown, Ohio	Westinghouse
254	*6000	600	6600	60	Geared	Roughing mill, stand 5	Armco	Middletown, Ohio	Westinghouse

* Synchronous motors
† Induction motor.
① Twin motor drive.
② Double armature.
③ Triple armature.
④ One-half double armature.
⑤ Denotes AISE Mill Motor frame when used.
⑥ Present motor used for one half twin drive.

MOTOR RECAPITULATION

Company	Location	Type of mill	Number of motors	Total horsepower
Allegheny Ludlum Steel Corp.	Brackenridge, Pa.	Sendzimir mill	5	3000
Altos Hornos	Montclova, Mexico	38 x 96-In. blooming mill	2	6000
Aluminum Co. of Canada	Kingston, Ontario, Canada	Aluminum foil mill	1	1000
American Brass Co.	Terre Haute, Ind.	Single stand aluminum cold mill	3	1900
		Brass non-reversing mill	1	600
		21 x 53 x 60-In. hot strip mill	2	4000
		30 x 56 x 96-In. reversing slabbing mill	1	4000
Armco Steel Corp.	Butler, Pa.	42-In. reversing cold strip mill	5	8300
		Sendzimir mill	5	4550
		3-Stand cold mill	4	4000
	Middletown, Ohio	Hot strip roughing train	5	18,850
		Cold mill	2	5000
Atlas Steels, Ltd.	Welland, Ontario, Canada	Reversing cold strip mill	1	350
Bethlehem Steel Co.	Steelton, Pa.	28-In. blooming mill	2	6000
	Sparrows Point, Md.	45 x 90-In. slabbing mill	3	16,000
Blaw-Knox Co.	Austria Export	50-In., 4-high, 1-stand foil mill	2	700
Breedband	Netherlands	2-Stand, 4-high, temper mill	6	3000
Canada Foils, Ltd.	Canada	36-In., 4-high, 1-stand mill	1	300
Cia Pacifico	Chile	4-High, reversing hot strip mill	1	4000
Cochran Foil Co.	Louisville, Ky.	60-In., 4-high, 1-stand foil mill	3	1150
Copperweld Steel Co.	Warren, Ohio	20-In. billet mill	4	4000
Crucible Steel Co. of America	Midland, Pa.	60-In. sendzimir cold mill	3	4300
Detroit Steel Corp.	Portsmouth, Ohio	54-In. hot strip mill	1	3500
Dominion Iron & Steel, Ltd.	Sidney, Nova Scotia, Canada	Billet mill	1	4000
Eastern Stainless Steel Corp.	Baltimore, Md.	50-In., 2-high 1-stand, non-reversing skin pass mill	1	300
Ekco-Alcoa	Wheeling, W. Va.	Non-reversing aluminum foil mill reel	1	500
Empire Steel Corp.	Mansfield, Ohio	Roughing mill	1	5000
Empressa Siderurgica	Medellin Colombia	10-In. merchant mill	1	750
Ford Motor Co., Steel Division	Dearborn, Mich.	42 x 32-In. billet mill	1	6000
Granite City Steel Co.	Granite City, Ill.	56-In. single stand temper mill	2	600
		56-In., 4-high tandem cold strip mill	4	11,200
Hojalata Y. Lamina	Monterrey, Mexico	Scalebreaker	2	600
		Reversing cold mill main drive	3	3250
Inland Steel Co.	East Chicago, Ind.	56-In., 2-high temper mill	3	2200
		56-In., 4-stand tandem cold mill	5	21,200
		76-In., hot strip roughing train	3	11,125
		45 x 90-In. slabbing mill	3	16,000
Jersey Shore Steel Co.	Jersey Shore, Pa.	16-In. rail slitting mill, roughing stand	1	400
		12-In. mill finishing train	1	800
Johnson Mfg. Co.	St. Louis, Mo.	62-In., 4-high, 1-stand foil mill	1	450
Jones & Laughlin Steel Corp.	Cleveland, Ohio	Sendzimir mill	3	5250
Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Reversing cold mill	2	750
		42-In. bright strip mill	1	400
		62-In. foil mill	1	500
		72-In. non-reversing aluminum foil mill	1	800
		Rod mill	1	800
		Skin pass mill	1	1250
Kaiser Steel Corp.	Fontana, Calif.	2-Stand temper mill	2	1200
		86-In. hot strip mill	6	32,000
		Slabbing mill	2	9000
Kelsey-Hayes Wheel Co.	McKeesport, Pa.	Taper disc rolling mill	2	800
Lone Star Steel Co.	Lone Star, Texas	Tube stretch mill	1	800
Olin-Mathieson Chemical Co.	Clarington, Ohio	2-Stand aluminum cold mill	4	6000
		Single stand aluminum cold mill	3	3635
		96-In. aluminum slabbing mill	5	11,900
Pittsburgh Steel Co.	Monessen, Pa.	30-In., 6-stand billet mill	6	10,500
Republic Steel Corp.	Cleveland, Ohio	98-In. hot strip mill	5	24,300
	Chicago, Ill.	16-Stand, 11-in. merchant mill	16	9900
Reynolds Metal Co.	Louisville, Ky.	Aluminum foil mills (4 units)	4	1450
		23 x 49 x 66-In., 2-stand tandem cold mill	2	4500
	Listerhill, Ala.	170-In. aluminum slabbing mill	2	7000
Reynolds Tobacco Co.	Winston Salem, N. C.	56-In., 4-high, 1-stand aluminum foil mills (3 units)	3	2000
Riverside Metals Co.	Riverside, N. J.	4-High, non-reversing cold breakdown mill	1	1000
Scovill Mfg. Co.	Waterbury, Conn.	Sendzimir mill	3	2050
Signode Steel Strapping Co.	Weirton, W. Va.	Single stand, 16-in., reversing cold mill	1	800
Stanley Works	New Britain, Conn.	Sendzimir cold reversing mill	5	3550
Steel Co. of Canada, Ltd.	Hamilton, Ontario, Canada	56-In., single stand temper mill	7	2450
		46 x 100-In. blooming mill	2	10,000
Tennessee Coal & Iron Div. U. S. Steel Corp.	Fairfield, Ala.	19 x 53 x 48-In., 2-stand temper mill	10	4800
Tata Iron & Steel Co.	Jamshedpur, India	Sheet bar and billet mill rougher	1	6000
		Sheet bar and billet mill continuous finishing train	9	12,000
		Structural mill	11	15,300
		28 x 72-In., reversing mill	1	3500
		46-In. blooming mill	2	10,000
Union Carbide Nuclear Co.	Oakridge, Tenn.	4-High reversing mill	1	500
U. S. Steel Corp.	Gary, Ind.	Universal slabbing mill	6	16,000
		No. 2 rougher	1	5000
	South Works, Chicago, Ill.	53-In. x 34-in. structural mill	10	33,500
		Blooming mill	4	12,000
	Clairton, Pa.	40-In. blooming mill	2	8000
Vanadium Alloys Steel Co.	Latrobe, Pa.	12 x 10-In. merchant mill	1	1000
		Bar mill	1	1000
Wallingford Steel Co.	Wallingford, Conn.	26-In. sendzimir mill	3	1900
Westinghouse Electric Corp.	Pittsburgh, Pa.	22-In. reversing mill	1	300
Wolverine Tube Co.	Detroit, Mich.	Tube mill	1	600

Types of motors purchased	Number of motors	Total horsepower
Alternating-current motors	28	93,350
Direct-current motors	226	381,510
	254	474,860

(*Continued from page 165*)

static regulating systems to obtain a coordinated overall static system.

One of the outstanding features of this type of control is the low input power level which presents a number of design opportunities. One application is a new type of limit switch. Through the use of static elements, a limit switch and a push-button that have no contacts have been developed.

In one steel plant, a static control system is used for blast furnace charging, and includes complete automatic sequence control for the coke system, skip hoist, distributor, small bell, stock-line recorders and large bell drives.

Another application of static switching in the steel industry was made at the Indiana Harbor plant of Youngstown Sheet and Tube Co. on a four-stand tandem cold mill. The switching system was combined with an existing static regulating system on the mill to give a coordinated overall static control system.

Another new basic control device gives possibilities for more simplified automatic control. This device consists of a stop motor incorporated in an automatic control system which permits a multiple series of operations to be programmed on tape or punched cards for complete automatic operation of machine tools. The special motor, which is the heart of the system, has a high degree of precision and rapid operation, and with its special amplifier can eliminate a great deal of complex equipment.

Another type of electronic control uses a motor which is essentially a linear actuator, providing a powerful feed mechanism accurately controllable in microinches. It is a logical successor to the lead screw in mechanisms requiring microinch dimensional control. The actuator employs a physical phenomenon called the magnetostrictive effect. The armature of the motor shrinks under the influence of an electro-magnetic field, snapping back to its original size when the magnetic field is deenergized. A pair of clamps convert the expansion and contraction undulations into forward or backward motion, reversing on demand without backlash. The unit has replaced lead screws on many machine tool operations, and has consistently repeated to an accuracy of plus or minus 0.000005 in. under machine load conditions which require a break-loose force of 300 lb and a sliding force of about 220 lb.

Mathematicians have developed a new "electronic brain" which may revolutionize control of complex industrial processes. This control has a built-in intelligence which enables it to distinguish between right and wrong decisions, and which can decide at each step whether the step just taken was right or wrong. The next step it takes is based on this decision.

Many of the arc furnaces purchased recently have electrode systems designed for speeds up to 18 fpm or more during regulating duty, much faster than was common on large furnaces a few years ago. Some of this increase in speed comes from selection of appropriate gear ratios and electrode motor hp, some from controls using rotating or magnetic amplifiers in adjustable voltage systems. Large electrode motors have little effect on accelerating time of the system since most of the inertia of the system is in the motor itself.

A new magnetic material promises to yield more powerful permanent magnets. This material is virtually 100 per cent pure manganese-bismuth. The magnetic properties are so promising that future design and performance of many present day devices may be affected. The material is unusually resistant to demagnetization, making it especially promising for use in external magnetic fields.

At the beginning of the year, the high price of copper was promoting the use of aluminum for conductor applications. With the break in the copper market before the end of the year, some of this pressure was off aluminum. However, development of a new insulation for aluminum wire should increase the metal's use. Relatively inexpensive, the new process provides a thin and durable coating which is essentially an oxide layer, giving an insulator almost immune to the effects of high temperatures. The coating does not have the usual brittleness of the older anodized coatings at least as far as coil winding is concerned.

A new light source which by-passes the incandescent bulb (which produces light from a point) and the fluorescent lamp (which produces light from a line) produces light from an area. Light comes from specially treated panels which light when electricity is applied. The panels consist of thin glass plate coated with a transparent conductive film over which is spread a layer of phosphor-embedded plastic topped off with an aluminum overlay. As electricity is applied to the two conductive layers, the phosphor between lights up. The panels can be operated through two control inputs, one of which will vary brightness and the other color, and many shades of color can be produced from white to blue to red. Widespread use is not now economical as efficiency is low. However, the upper theoretical limit of efficiency is much higher than those of incandescent or fluorescent lamps.

Other developments in light may have some interesting applications. X-ray images on TV can be made about 10,000 times brighter than on a conventional fluoroscope screen. This development can be adapted to industrial inspection uses. The basis for this lies in the direct conversion of X-ray images to electrical signals. Conversion is made by a sensitive lead oxide layer that is coated on the face of a TV pickup tube.

Another device is the supersensitive TV camera tube that will work on low intensity light sources only, and is said to produce an image 40,000 times brighter than it will appear to the naked eye. It can reveal a blacked-out scene as a bright television picture.

Another new light source consists of a disc of refractory material which is put in a high-frequency electromagnetic field. The disc gets hotter than tungsten light filaments, and the higher the temperature of the light source, the more energy shows up as useful light.

On a laboratory scale, electricity has been produced directly from the reaction of hydrogen and oxygen without the many steps involved in conventional power generation. An experimental fuel cell shown during the year consists of two carbon tubes mounted in a closed container filled with a fluid electrolyte. The carbon tubes are differently catalyzed, one for hydrogen activation, the other for oxygen activation. Power from this cell will light a small bulb.

Sales of main drives during the year were about the third highest in history. The horsepower of main roll drives sold in 1956 totaled 474,860 hp from 254 motors, of which 226 were d-c, and 28 were a-c.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, February 25, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

"Expansion in Electric Arc Furnace Melting in Southern Plants," by W. E. Lewis, Vice-President, Lectromelt Furnace Co., A McGraw Electric Co. Division, Pittsburgh, Pa.

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Tuesday, February 12, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

"Application and Maintenance of Back-up Bearings," by Sam Carson, Field Engineer, Morgan Construction Co., Worcester, Mass.

Hotel Sheraton, 715 Delaware Avenue, Buffalo, N. Y.

CHICAGO SECTION

Tuesday, February 5, 1957—Dinner 6:30 P.M., Meeting 7:30 P.M.

"The Approach to Steel Mill Lubrication at the Gary Works, U. S. Steel," by Col. Frank L. Gray, Lubrication Engineer, Gary Works, United States Steel Corp., Gary, Ind.

Phil Smidt's Restaurant, 1205 North Calumet Avenue, Hammond, Ind.

CLEVELAND SECTION

Tuesday, February 19, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

"On Industrial Stream Pollution," by John E. Kinney, Sanitary Engineering Consultant, Ann Arbor, Mich.

The University Club, 3813 Euclid Avenue, Cleveland, Ohio

DETROIT SECTION

Wednesday, February 13, 1957—Dinner 6:30 P.M., Meeting 8:00 P.M.

Detroit Edison Night

" 'CYPAK'—A New Static Control System," by F. C. Fennell, Westinghouse Electric Corp., Detroit, Mich.

"The Trend in Open Hearth Fuels," by C. R. Schmitt, E. F. Houghton & Co., Philadelphia, Pa.

"Experience with Oxygen in Open Hearth Furnaces," by Carl A. Snider, Kaiser Aluminum & Chemical Sales, Inc., Detroit, Mich.

Dinner—Cafeteria, General Office Building; Meeting—Sales Auditorium—Service Building

LOS ANGELES SECTION

Data Not Available

PHILADELPHIA SECTION

Saturday, February 2, 1957—Dinner 6:00 P.M., Meeting 7:00 P.M.

"New Ore Handling, Screening and Sintering Facilities at Sparrows Point"

"Engineering and Mechanical Features," by Melvin Becker, Engineer, Engineering Department, Bethlehem Steel Co., Sparrows Point, Md.

"Electrical Features," by E. C. Olson, Assistant General Electrical Foreman, Sheet, Tin and Strip Mills, Bethlehem Steel Co., Sparrows Point, Md.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

PITTSBURGH SECTION

Monday, February 18, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Reducing Smudge on Cold Rolled Sheet," by Michael A. Matz, Special Technical Assistant, Continuous Sheet & Strip Dept., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

University Club, University Place, Pittsburgh, Pa.

ST. LOUIS SECTION

Wednesday, February 27, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Gaging of Metals," by J. W. Hopper, Jr., Gage Application Engineer, Pratt & Whitney Corp., West Hartford, Conn.

Elks Club, Granite City, Ill.

SAN FRANCISCO SECTION

No February Meeting

UTAH SECTION

Data Not Available

YOUNGSTOWN SECTION

Monday, February 25, 1957—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Automatic Control in the Steel Industry," by R. W. Holman, Director, Control Mechanisms, U. S. Steel Corp., Pittsburgh, Pa.

Mahoning Country Club, Girard, Ohio

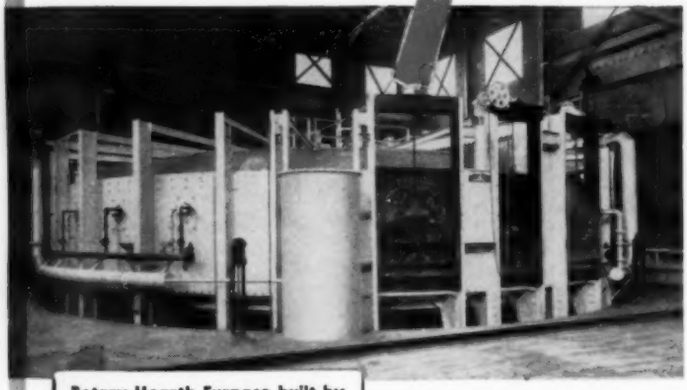
Four Open Hearth Furnaces designed by Rust for Lone Star Steel Company's modern steel mill at Lone Star, Texas

RUST

first

in design and construction of

metallurgical furnaces



Rotary Hearth Furnace built by Rust for a Pennsylvania plant

Hundreds of installations, throughout the world, offer convincing proof of Rust's leadership in furnace design and construction. For melting, reheating, or heat treating, you can rely on Rust for economical, automatic, trouble-free furnace efficiency.

A Type for Every Need

OPEN HEARTH FURNACES • SOAKING PITS • CONTINUOUS REHEATING FURNACES • CAR TYPE HEAT TREATING FURNACES • BOX ANNEALING FURNACES • CONTINUOUS PIPE ANNEALING • CONTINUOUS STRIP ANNEALING • GALVANIZING • WIRE PATENTING • ROLLER BOTTOM HEAT TREATING • SPECIAL FURNACES FOR SMELTING, ORE THAWING, POLYMERS DISPOSAL, COAL DRYING, AND OTHER USES.

THE WHOLE JOB IS ONE JOB WITH A "RUST PACKAGE CONTRACT"

One contract covers everything from original idea to start-up. One responsibility for design, manufacture, erection and initial operation. One overhead and one profit (with substantial savings to you) on all phases of the work, including wiring and piping.

Rust Furnace Company

Pioneers in Furnace Design

Rust Building • Pittsburgh, Pa.

Monitor Measures Oxygen Content in Flue Gases to give peak combustion efficiency

▲ A new flue gas monitoring system, which assures peak combustion efficiency, is bringing greater fuel economy in industrial plants. Designed by Leeds and Northrup Co., the system employs accurate and reliable analysis of the O_2 content as a measure of excess air, and can automatically adjust fuel-air ratio to maintain optimum combustion.

Industrial applications for the system cover a broad range of fuel-air combustion equipment, including power plant boilers, process heaters, cement kilns, SO_2 burners and steel open-hearths. Field experience with several thoroughly checked installations indicates that the controls offer a practical answer to many combustion control problems throughout industry.

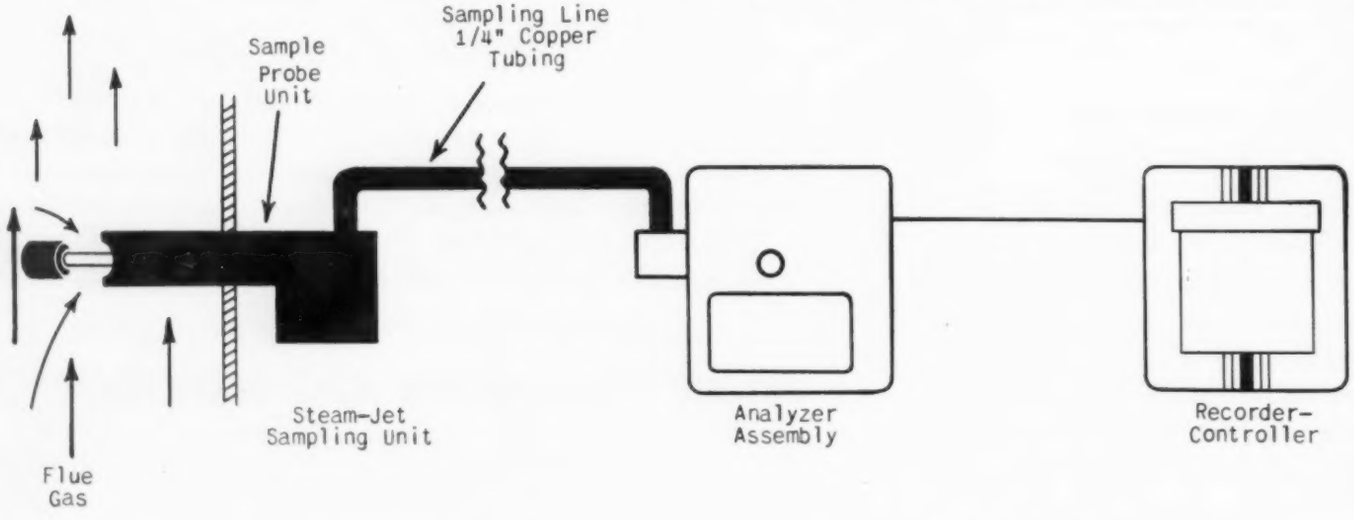
Through careful design of the sampling probe, gas cleaning unit and the analyzer, the new system provides: (1) high response speed in measurement, essential to proper control; (2) ability to handle dirty, high temperature flue gases; (3) continuous operation with a minimum of maintenance; and (4) means of obtaining a true average sample where O_2 content varies with location in flue.

In one typical installation on a twin furnace for superheat and reheat at Philadelphia Electric's Cromby Station, the system detects, within 13 sec, a change in flue-gas oxygen at the sampling point some 150 ft from the analyzer. The recorded oxygen content, obtained from three sample points and averaged, checks the average of Orsat readings within 0.2 per cent O_2. In operation over a year, the system has proved reliable and has won the confidence of operators and test engineers, requiring little attention other than routine maintenance.

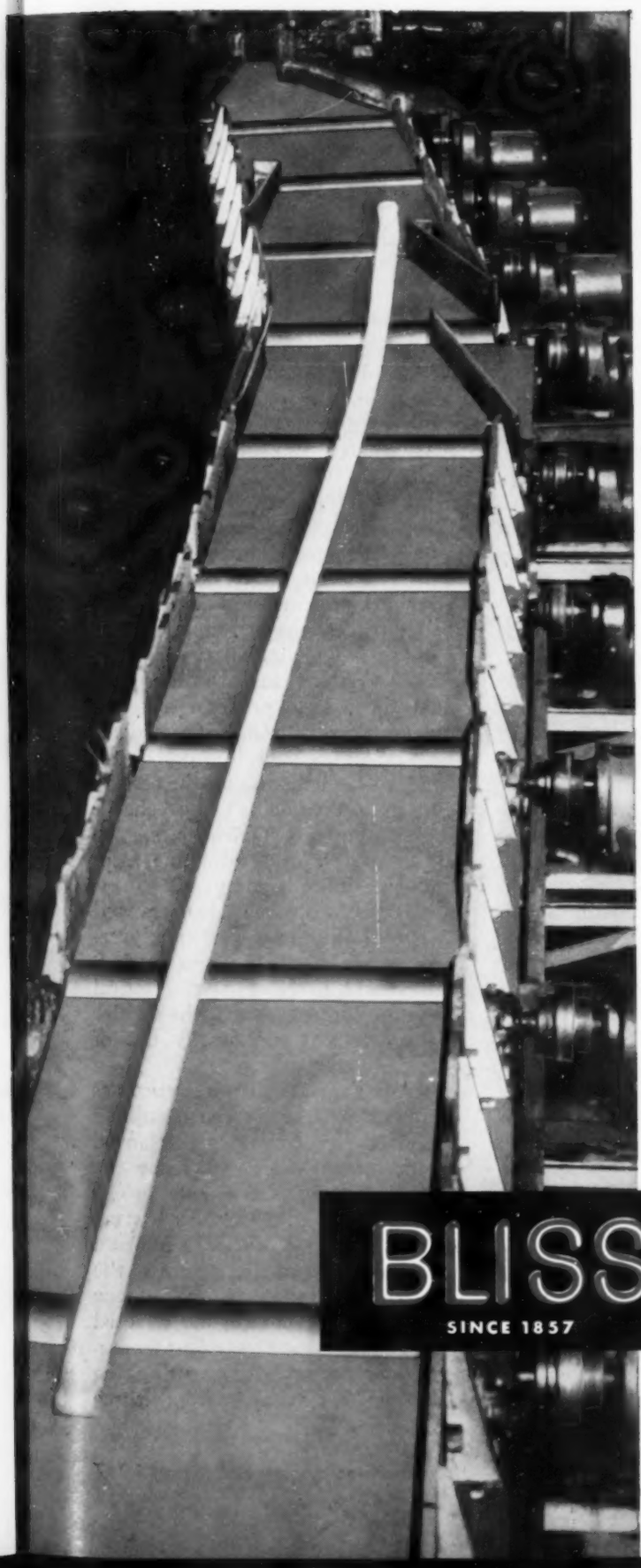
Combustion engineers have known for some years that O_2 content in flue gases is the ideal basis for combustion control. It provides a direct measure of excess air which operators want to hold at an optimum value. Too little air means wasted fuel due to incomplete burning; too much air means loss of valuable heat up the stack.

The O_2 content holds its direct relation to excess air in spite of variations in the fuel's heating value, specific gravity, or type. For example, 6 per cent O_2 in the flue gas indicates close to 40 per cent excess air with only a 0.1 per cent O_2 spread

Figure 1 — Schematic diagram shows basic components of the oxygen analyzer system for combustion control.



Special powered-roller tables speed handling at new Merchant Bar Mill



To meet growing demands for specialized bar products, Phoenix Manufacturing Company mechanized breakdown operations at its new bar mill with three specially-designed Bliss powered-roller tables:

- a "live" table speeds billets from furnace into a three-high roughing mill,
- a tilt table shoves them back into the roughing rolls during breakdown passes, and
- a runout table carries them into the first of six finishing mills.

Designed, built and installed by Bliss, these tables help Phoenix hit top production schedules at lower costs by cutting handling time to the bone. What's more, they're designed for fast, easy maintenance—to keep up a steady, shift-after-shift flow of bar stock.

These powered-roller tables, like all Bliss rolling mill accessory equipment, are built to your specific needs, installed under the supervision of Bliss field engineers and serviced by experienced engineering personnel. Why not get more information on Bliss rolling mills and accessory equipment? Write today for your copy of Catalog 40-A—Bliss' 60-page Rolling Mill Brochure.

Bliss-designed "live" table was installed during mill construction.

E. W. BLISS COMPANY, General Office: Canton, O.
ROLLING MILL DIVISION: SALEM, OHIO
Presses, ROLLING MILLS, Special Machinery

is more than a name
... it's a guarantee

Plants at Canton, Cleveland, Salem and Toledo, Ohio; Detroit and Hastings, Michigan; Midland and Pittsburgh, Pennsylvania; San Jose, California
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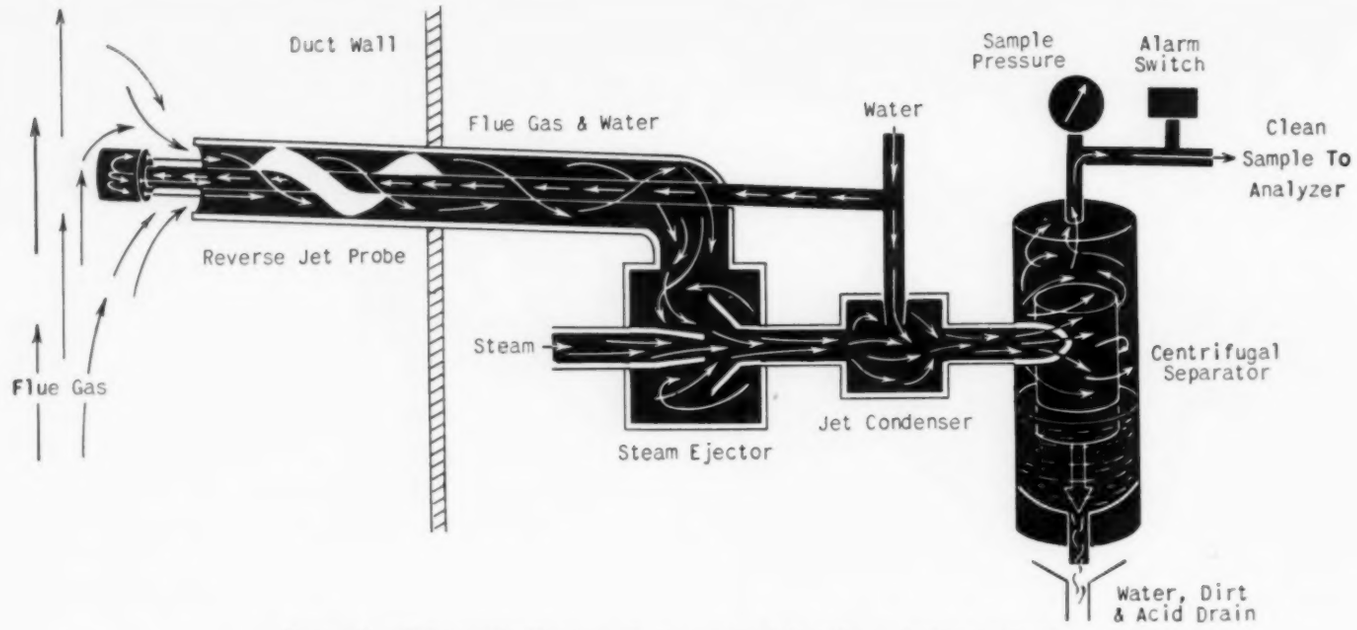


Figure 2 — Schematic diagram shows reverse jet probe and steam sampler.

between values for natural gas and oil. On the other hand, the spread between CO_2 readings at 40 per cent excess air for oil and gas is approximately 3.5 per cent CO_2. This means that with CO_2 the operator has no direct, meaningful index of excess air when mixed fuels are fired. O_2 on the other hand measures excess air directly.

BASIC COMPONENTS OF SYSTEM

The control system has four basic components: (1) one or more probe units for gas sampling; (2) a gas cleaning unit for each probe; (3) magnetic-type O_2 analyzer assembly; and (4) electronic recorder-controller for O_2 (see Figure 1). As covered below, certain auxiliary equipment is employed on specific installations to meet industrial requirements.

A key component, making the system practical for industrial use, is the reverse jet probe and associated steam sampler (see Figure 2). Three water jets from the reverse jet head on the probe end keep the probe clean with a high velocity, swirling stream. A steam ejector provides a strong suction to draw the flue gas sample into the probe and force it at high speed to the analyzer.

A jet condenser and centrifugal separator (see Figure 2) clean the flue gas sample which passes to the analyzer through standard ¼-in. copper tubing under a pressure of 3 to 6 psig. This line to the analyzer can be up to 200 ft long with as little as six sec lag in sampling.

The gas sample enters the analyzer through a separator which removes any condensate formed in the sampling line. It then passes through a filter and by-pass assembly which maintains a constant rate of flow through a rotameter to the analysis cells.

In the analyzer, the oxygen content is measured by the unique paramagnetic properties of oxygen (i.e., it is strongly attracted to a magnetic field). Through an electrical circuit, designed to eliminate errors due to changes in sample gas or atmospheric pressure and variations in supply voltage, the analyzer compares the O_2 content of the flue gas to the very stable O_2 content of atmospheric air and produces a signal directly proportional to the O_2 content of the flue gas. The electronic recorder measures this signal and records the O_2 content directly in per cent of oxygen (scale range is normally 0 to 5 per cent O_2, or 0 to 10 per cent O_2).

USE OF MULTIPLE PROBES FOR AVERAGE SAMPLE

In modern boilers having big ducts, or in process heaters, stratification of flue gas is a common cause of misleading information about combustion. Gas sampling traverses made by test engineers across the ducts on big boilers show that O_2 readings can be 1.5 per cent O_2 apart—in the same duct and at the same time. This corresponds to a variation of about 10 per cent in excess air. In refinery bridgewall type heaters, the O_2 variation can be even greater from side to side in the furnace.

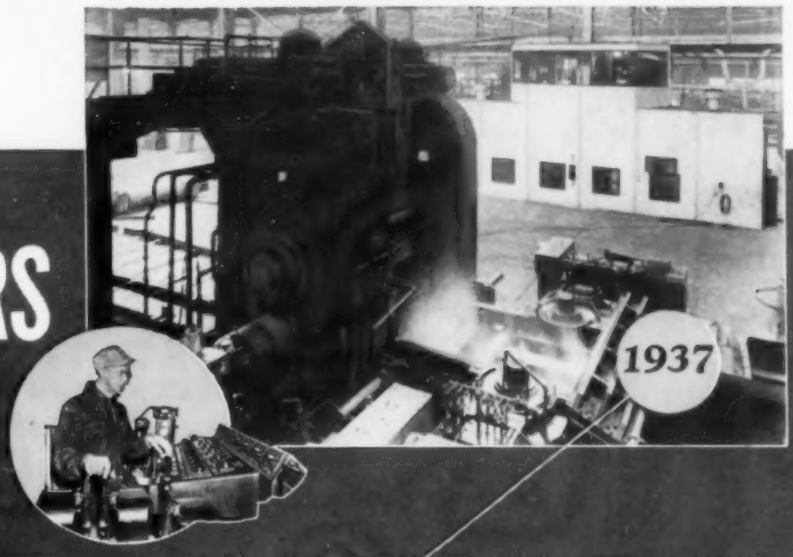
At the Cromby Station, each furnace has three sampling probes which feed a panel-mounted sample-averaging unit. Here, samples are combined on a metered flow basis to get a true average sample for the analyzer. This installation also includes a third test recorder and analyzer which permits test engineers to traverse either the superheat or reheat duct, one probe at a time, without disturbing the control system operation. These checks can show up any inefficiencies, such as improper burner adjustments or unbalanced fuel feeding.

The test recorder is also arranged to check either of the two analyzer-controllers. Also, the test system can be cut into the automatic control from the control room, if the regular controllers are temporarily out of service.

In bridgewall type refinery process heaters, at least three sampling probes are located along the length of the bridgewall. By checking the O_2 content at each sample probe, operators can adjust the air louvers on the burners to produce uniform combustion conditions across the furnace. Automatic control of the flue dampers can then be effected by measuring the O_2 content from a single probe, or by measuring the average O_2 content from three probes.

20 YEARS OF EC&M DESIGN LEADERSHIP!

IN AUTOMATIC-POSITIONING SCREWDOWN CONTROL



20 YEARS AGO, EC&M Automatic-Positioning Screwdown Control was installed in this mill. It has been doing an outstanding job ever since.

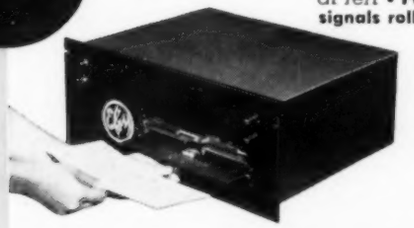
Since then, this same basic EC&M system has been installed in nearly 50 other mills—including blooming mills, billet mills, beam mills, plate mills and reversing roughers ahead of hot strip mills.

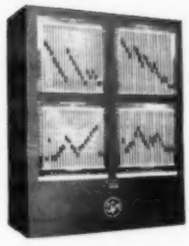
Now, this same proven system has been expanded to provide programming either by punched cards or by slider panels—for new or existing installations, operated from either constant or adjustable voltage.

1957

PROGRAMMING NOW AVAILABLE BY PUNCHED CARDS OR SLIDER PANELS

at left • Punched Card Reader automatically signals roll setting for each pass





at right • Slider Panel provides roll settings for 2 complete schedules. Pistol grip switch provides immediate transfer from one to the other

above • TIME-CURRENT Screwdown Controller with Magnetic Amplifier Control and Relay Panel

EC&M DESIGN ADVANTAGES

- A single pushbutton controls the most important operation in rolling. Screwdown rolls accurately set for each pass. No schedule to remember.
- Ability to change from automatic to manual and back again, instantly available to the roller.
- EC&M system is direct reading. No coding and de-coding requiring multiplicity of relays.
- Easily serviced by regular maintenance crew. Simple adjustment for roll changes.
- Over 900 roll positions obtainable from only 2 small (main and vernier) face-plate, positioning switches.
- New operators quickly trained.

They all add up to GREATER TONNAGE— ACCURACY— QUALITY

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THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

CLEVELAND 28 • OHIO

7930

PUNCHED CARD SYSTEM CONTROLS LATHE OPERATION

Figure 1 — Operator places a series of punched cards into the numerical positioning control which directs the operation of the lathe.

▲ MORE than one year of experimental operation of what is believed to be the nation's first punched-card-controlled lathe indicates that it is now possible for users to speed production cycles by going directly from process drawings to finished pieces.

Experiments conducted by the Sundstrand Machine Tool Co. show that application of the recently developed General Electric numerical positioning control to the new Sundstrand model 14 multi-cycle, single-point production lathe has made it practical to punch control cards directly from process drawings. Once the cards are punched, direct production operations are then possible.

Test results also reveal that use of the numerical positioning control has on many jobs brought about an 80 per cent reduction in setup time and a consequent boost in production. This has made it possible for the Sundstrand machine to produce a wide range of parts with a minimum of changeover time.

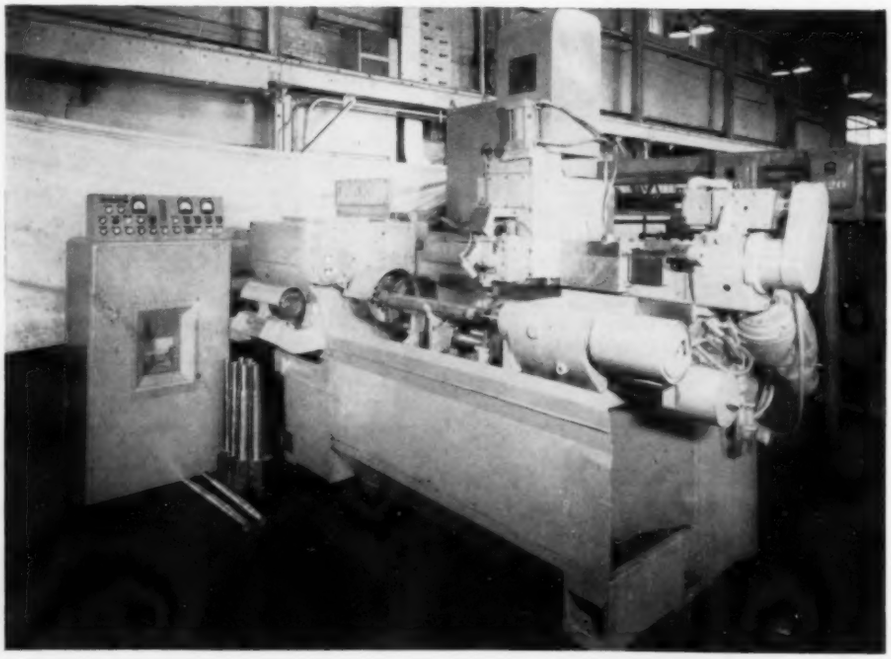
The rapid changeover feature is especially significant on small lot jobs. When a changeover in cutting a different piece or cutting an entirely new piece is made on an ordinary lathe, the change may require many minutes. Change time for a comparable job on the Sundstrand Model 14 is only the time required to change the deck of cards. In addition, lathe operation has been simplified by providing ease of adjustment and a reduction of manual operations.

Tests have shown that one man can efficiently operate as many as five punched-card-controlled lathers simultaneously, depending upon the cutting cycle. Moreover, the operator can adjust the lathes for a wide variety of preprogrammed jobs merely by changing the control cards which direct the machine's operation.

In its present application, model 14 is used for general step turning. Punched cards control the speeds and feeds at which the machine operates. Using this type of control, the lathe has a range of eight spindle speeds and feed rates. It is capable of roughing or finishing over the range of 280 to 2025 rpm spindle speeds, and 7½ to 29½ in. per min. longitudinal feed.

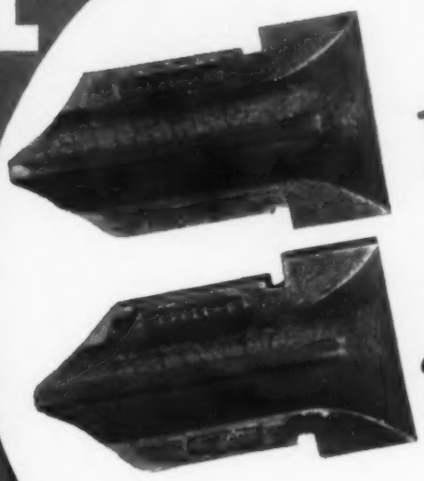
The numerical positioning control which directs the operation of the new Sundstrand lathe was developed by General Electric's Specialty Control Department, Waynesboro, Va.

Figure 2 — The numerical positioning control is shown on left and the lathe, which it operates is on the right.



TRANTINYL GUIDES THE STEEL INDUSTRY

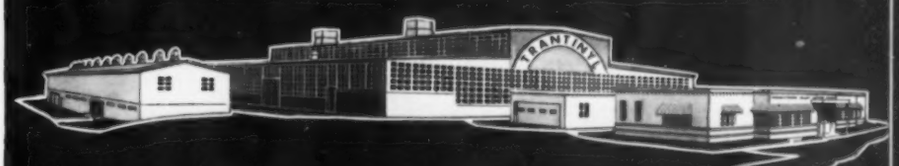
U. S. Steel Gary Works rolled 100,000 TONS with this pair of "TRANTINYL" GUIDES



These entry guides on finishing stand, 14" mill, were photographed after rolling 100,000 tons of rounds. Guides were still in serviceable condition.

14" Mill, Gary Works, with "TRANTINYL" Guides and Guide Box

"Trantinyl" Guides and Rollers hold exceptionally high tonnage performance records, in serving leading steel mills for a quarter-century.



Youngstown Alloy Casting Corporation
Youngstown, Ohio

Sole Licensee to cast "TRANTINYL" for the Midwest, West and South: WAUNAKEE ALLOY CASTING CORP., Waunakee, Wis.

HOW TO CONTROL ATMOSPHERES...

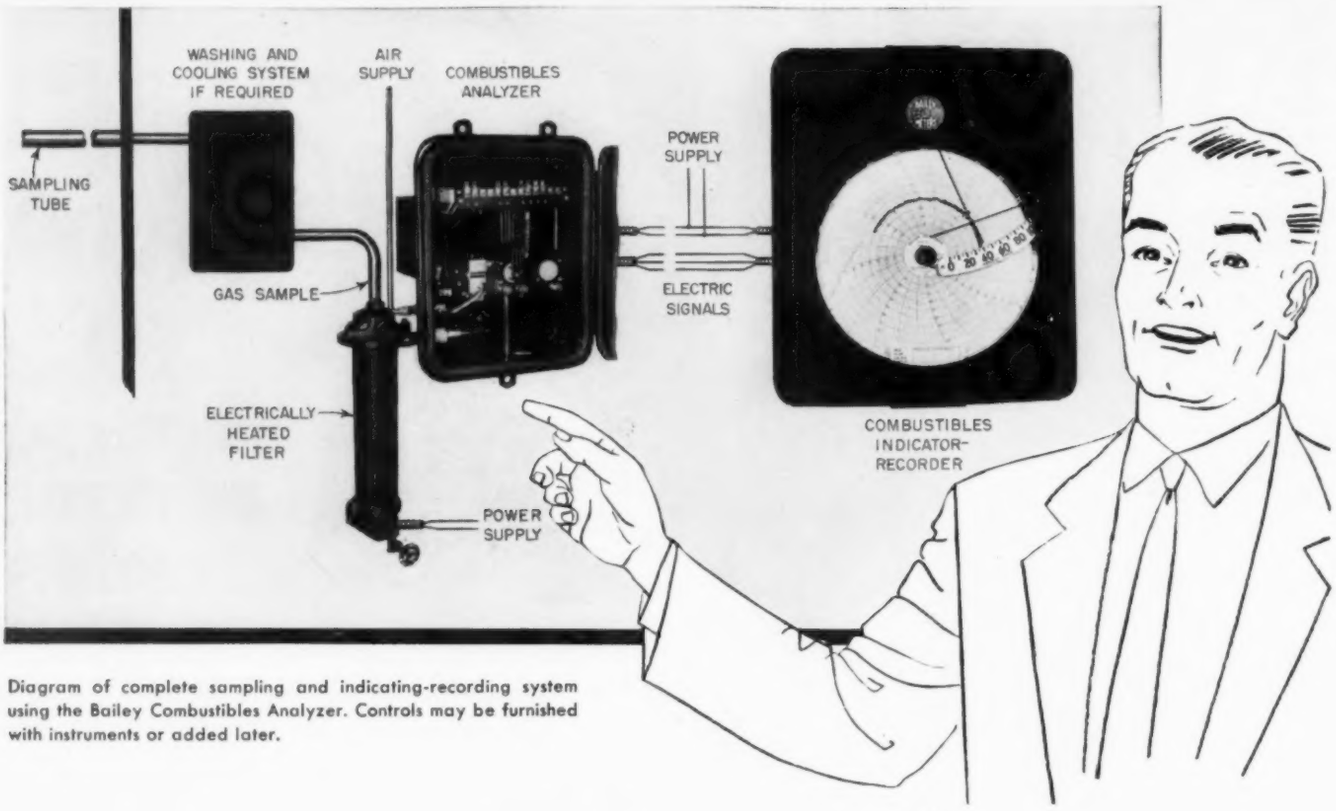


Diagram of complete sampling and indicating-recording system using the Bailey Combustibles Analyzer. Controls may be furnished with instruments or added later.

BAILEY COMBUSTIBLES ANALYZER

improves steel quality, saves gas

Whether you are doing bright annealing, hardening, normalizing or carburizing, keeping a constant watch on your atmospheres with a Bailey Combustibles Analyzer will help you do a better job at lower cost. This instrument provides a continuous measurement of the per cent combustible in the protective atmosphere gasses. It operates a remote electronic receiver for indicating, recording and controlling.

The Bailey Combustibles Analyzer monitors the quality of atmosphere gas. When the quality changes, as shown by changes in the per cent combustibles, the Analyzer operates a pneumatic controller which automatically controls the fuel rate. By maintaining the proper gas-air mixture, the uniformity of the atmosphere—and of the final steel product—is protected.

An important use for the Bailey Analyzer is in furnace purging—necessary to prevent explosion during startup. The instrument tells the operator when the combustibles have been reduced to a point where it is safe to start up the furnace. Without a Bailey Analyzer, purging is usually done strictly on a time basis, a procedure that is wasteful and unsafe.

Put the Bailey Combustibles Analyzer to work as a watchdog and control on your atmosphere generators and heat treating furnaces. It is the one way you can be sure you are maintaining the atmospheres specified by metallurgists for your processes.

Your Bailey Engineer will show you how you can use this instrument to improve steel quality and save gas. Or, write to our Iron & Steel Division for Product Specification E65-3 with complete details. 58-1

BAILEY METER COMPANY

IRON AND STEEL DIV., 1047 IVANHOE ROAD, CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

INSTRUMENTS AND CONTROLS FOR POWER AND PROCESS

BAILEY METERS

BAILEY BUILDING BLOCK METHOD

Even truer today

We ran this **B&W Insulating Firebrick** advertisement in 1947

24 years now

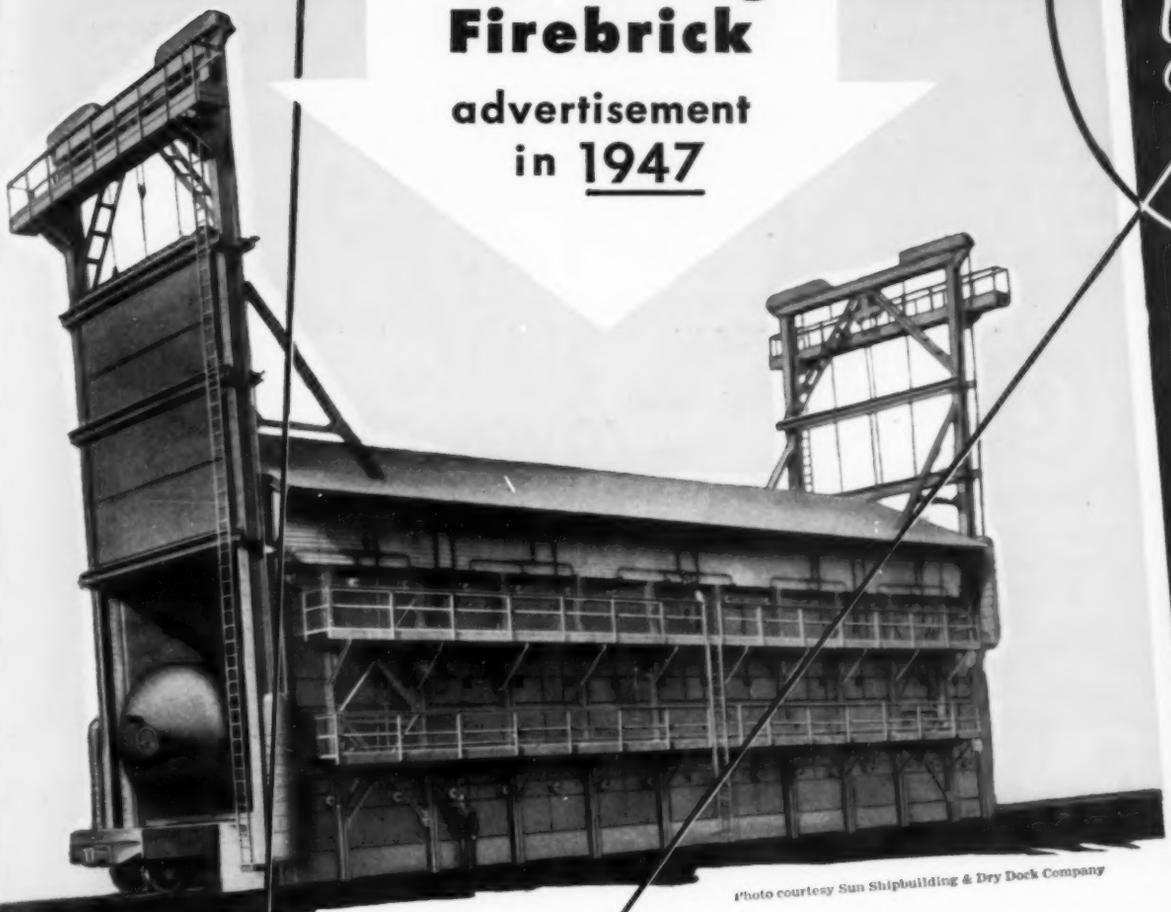


Photo courtesy Sun Shipbuilding & Dry Dock Company

Only in main arch approximately 2 feet from each end of the furnace

The furnace that PAID FOR ITSELF MANY TIMES OVER

Still lined with its original B&W Insulating Firebrick after 15 years of normalizing and stress-relieving service, this furnace is giving exceptional performance. Despite the added strain of the rigorous war years, the 80,000 B&W IFB used to line sides, ends and arch have required no appreciable maintenance!

It is no wonder the operators can report:
"This furnace has paid for itself many times over."

For furnace performance that assures highest production at lowest cost, even after years of grueling service, you can always count on lightweight B&W Insulating Firebrick. Your local B&W Refractories Engineer will be glad to help you select economical B&W Refractories for your furnaces.

B&W REFRACTORIES PRODUCTS:

B&W Allmul Firebrick • B&W 80 Firebrick •
B&W Junior Firebrick • B&W Insulating Firebrick
B&W Refractory Castables, Plastics and Mortars
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R550

Frequent Instrument Check-ups Prevent Emergencies

The economical way to protect your plant's investment in instrumentation is a Honeywell Periodic Service Plan. Under this plan, a Honeywell service specialist comes to your plant at regular intervals to—

- — Check your Brown instruments and calibrate them against accurate laboratory standards.
- — Inspect all moving parts, clean and lubricate them, and replace where necessary.

You get this kind of service performed regularly for your office equipment such as typewriters and calculating machines . . . for your automobile . . . and even for yourself by periodic check-ups by your doctor. You've learned that the ounce of prevention is a good investment. Well, the same philosophy applies to instruments, too. Keeping them in good condition is far more economical than waiting for emergencies to throw production schedules into a tailspin.

Here, briefly, is what the Honeywell Periodic Service Plan does. It provides:

Periodic examination and adjustment by a factory-trained service engineer.

Automatic attention. Calls are made on a schedule that fits your own requirements . . . at a cost substantially lower than an equivalent emergency service call.

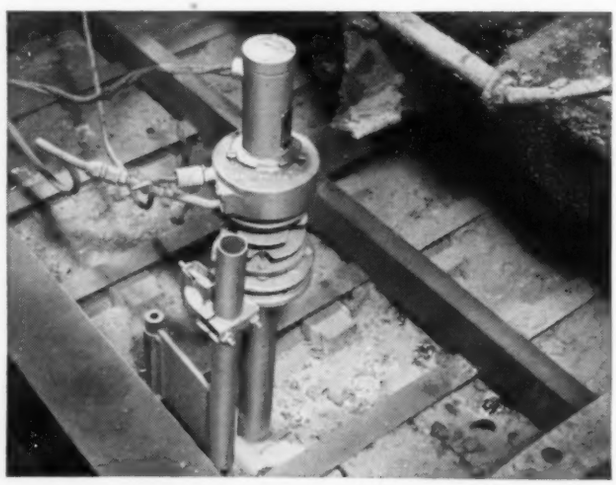
Continuous operation. Good instruments kept in top condition can be counted on for steady duty, without costly shut-downs. Well-maintained instruments last longer, too.

Increased plant efficiency. Greater reliability of operation builds confidence of plant personnel in their equipment.

At any time, of course, you can count on prompt emergency service from any one of the more than 100 Honeywell service centers spotted throughout the United States and Canada.

The Plan is extremely simple. It costs remarkably little, and can pay real dividends in protection of your production schedules and your instrument investment. For details about how it can be applied to your own plant, call your local Honeywell office.

Brown controls for Lukens pits boost quality and



Soaking pit temperatures are detected by a ***Radiamatic*** *unit installed in the pit cover.*

From this control cubicle, the operator can supervise automatic control of temperatures and pressures in three soaking pits . . . can take over instantly on manual control when desired.

efficiency of steel production

MODERNIZING soaking pit operation by conversion from manual to fully automatic control . . . using Brown instrumentation . . . is helping Lukens Steel Company to make improvements in operation. Two regenerative soaking pits, each containing three holes, are now equipped with control centers from which temperature, draft and reversal timing are automatically regulated.

Mill personnel report that soaking temperatures are held more closely . . . heat distribution is maintained with more precision. Occasional overheat periods which inevitably occurred with manual control have been eliminated. Due to the improved temperature control on these units, more critical grades of steel are processed through them, helping to maintain high standards of quality.

Instrumentation for each pit includes an *ElectroniK* temperature controller, working with a *Radiamatic* element installed in the cover. A Brown Furnace Pressure Controller regulates draft to maintain the desired heat distribution and flow of combustion gases. At the turn of a switch, the operator can take over on manual control instantly, for emergency or start-up. Furnace reversal, normally automatically timed, can also be handled manually.

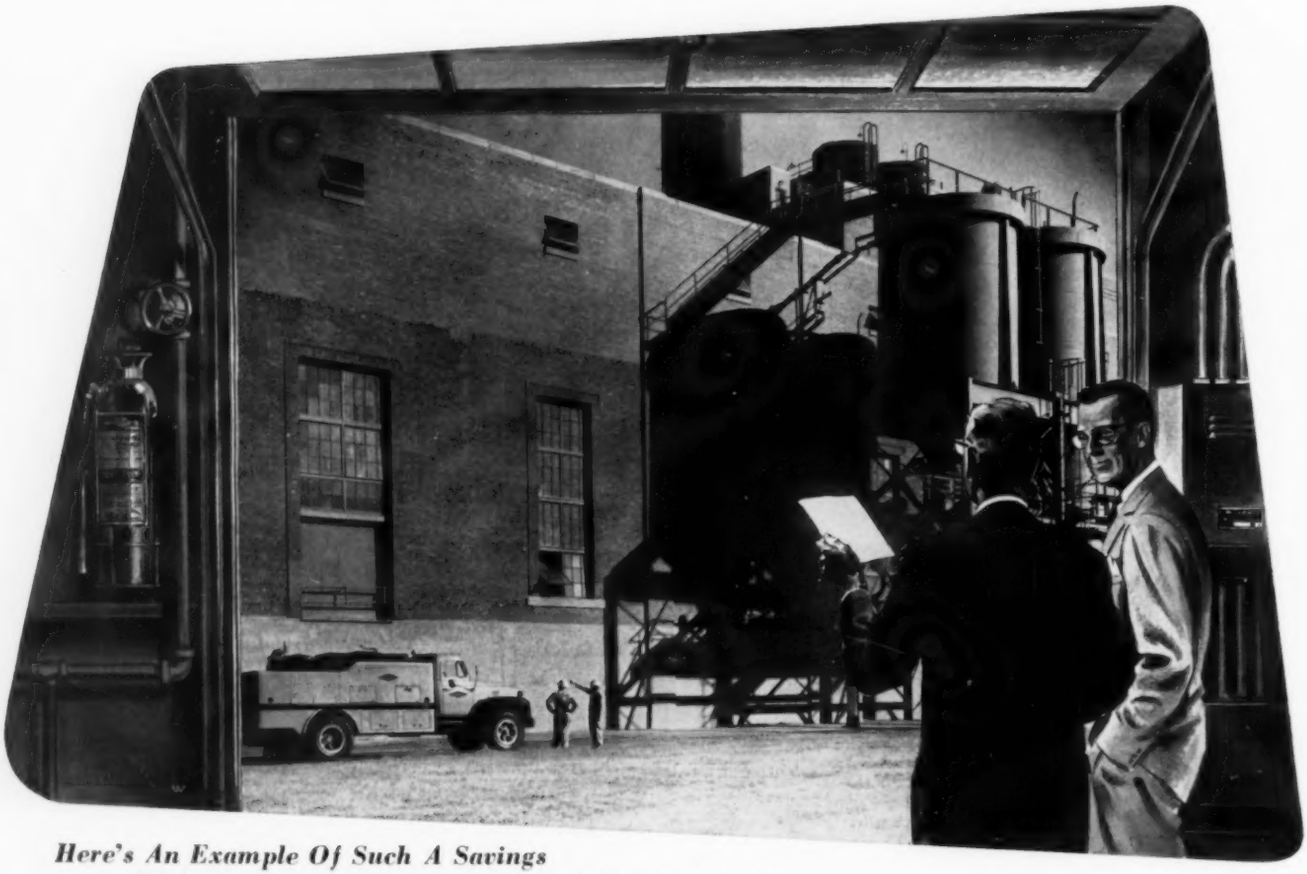
Modern instrumentation can help you to get top economy and productivity from either new or existing equipment. For a discussion of your own applications, call your local Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for Catalog 1531, "*ElectroniK* Controllers".**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

how much could you add to your profit-- by saving $50,000 per boiler cleaning?



Here's An Example Of Such A Savings Made Possible By Dowell Chemical Cleaning Service

Dowell recently chemically cleaned a 1,000,000 lb. per hour steam generator for one of its customers. Total outage time was 48 hours. This saved the company an estimated five to seven days down-time, as compared to mechanical cleaning methods.

Considering replacement power for a boiler of this capacity costs between $7,000 and $15,000 per day, it's easy to see a $50,000 savings. And, it's just as easy to project a $250,000 to $500,000 annual savings for a plant with five to ten such boilers.

This particular case history concerns a power company with a forward-looking operations manager. But, Dowell has other startling performance data to show you — from your own industry. That's because chemical cleaning is so versatile. Dowell engineers are experts in removing scale and sludge from process systems, tanks and piping. They apply solvents in various ways— such as filling, jetting, cascading. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

have Dowell clean it chemically **DOWELL**

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Date-line Diary...

December 1

▲ Shipments of iron and steel castings during August, 1956, amounted to 1,337,448 short tons compared with 934,935 short tons in July, 1956, and 1,435,166 short tons in August, 1955; shipments of these products in September, 1956, amounted to 1,334,369 short tons, and 1,480,794 short tons in September, 1955.

▲ AISC reports that bookings of fabricated structural steel in 1956 approximated 3,900,000 tons, about 7 per cent over 1955; shipments totaled close to 3,250,000 tons compared with 3,000,000 tons in 1955. The Institute reports expected bookings in 1957 to reach 4,050,000 tons, shipments to exceed 3,800,000 tons.

December 3

▲ The AISI reports that the operating rate of the steel industry for the week of December 3 is scheduled at 100.5 per cent of capacity. This is equivalent to 2,473,000 tons compared with 2,489,000 tons one week ago and 2,416,000 tons one year ago. Index of production for the week is 153.9.

▲ According to the AISC bookings of fabricated steel for October, 1956, totaled 290,961 tons compared with 245,617 tons in September, 1956, and 308,780 tons in October, 1955; shipments equaled 287,639 tons in October, 1956, 240,858 tons in September, 1956, and 283,768 tons in October, 1955. Backlog at October 31 amounted to 3,215,486 tons.

December 5

▲ Du Pont Co. announced a reduction of 25¢ per lb on top-grade titanium metal sponge, new prices are $2.75 from $3.00 on Grade A-1.

December 6

▲ INCO of Canada, Ltd. raised prices of nickel 9½¢ to 74¢ (U. S. Currency) a lb. The company also announced plans for a new mining and refining installation in northern Manitoba.

December 7

▲ According to government predictions spending on plants and equipment for the first quarter of 1957 will be at a $38,000,000,000 annual rate. Outlays in 1956 are scheduled to reach $35,000,000,000 up 22 per cent over 1955.

December 10

▲ The AISI reports estimated payroll for the iron and steel industry for October, 1956, at $358,935,000. Average hourly payroll cost of wage earners was $2.763 for each hour worked during October compared with 2.784 in September. In addition to the above, the hourly cost for pensions, social security and insurance amounted to 25.0¢ per hour. Working hours averaged 40.6 hr per week in October compared with 39.2 hr per week in September. Estimated number on payroll was 687,400.

▲ The AISI reports that the operating rate of the steel industry for the week of December 10 is scheduled at 102.0 per cent of capacity. This is equivalent to 2,511,000 tons compared with 2,493,000 tons one week ago and 2,421,000 tons one year ago. Index of production for the week is 156.3.

December 11

▲ Government figures showed that employment dropped to 65,300,000 in mid-December, off 900,000 from November. Unemployment rose to 2,460,000, up 550,000. Weekly earnings of factory workers rose from mid-October to $82.42 an increase of 21¢.

▲ At a special meeting on February 14 Alan Wood Steel Co. will ask its stockholders to raise the company's long term debt limit to $25,000,000 from $7,000,000 to provide for additional capital expenditures for plant expansion and improvements and working capital requirements.

December 12

▲ Bethlehem Steel Co. and Youngstown Sheet and Tube Co. announced intentions to proceed with the government-opposed merger plans, hanging fire since 1954 despite the prompt assertion of the Justice Department that suit would be filed within a few days to block the move.

December 13

▲ The government filed a suit in the U. S. district court in New York designed to block a proposed merger of Bethlehem Steel Corp. and Youngstown Sheet and Tube Co. The civil antitrust action said the merger would substantially lessen competition or tend to create a monopoly in violation of the antitrust laws.

December 14

▲ The Atomic Energy Commission disclosed that U. S. uranium oxide production has doubled since the start of 1956, is now running 8,000 tons annually. The Commission also reports that uranium ore reserves in the U. S. at November 1 totaled 60,000,000 tons. The Canadian government estimated their reserves at 225,000,000 tons.

▲ Mallory-Sharon Titanium Corp. plans to erect a large-scale pilot plant at Niles, Ohio, to refine titanium scrap, yielding extremely pure metallic titanium by use of a new electrolytic process.

▲ Electro Metallurgical Co. advised price increases effective Dec. 15, not applicable to contract users until Jan. 1, 1957, on some manganese and silicon alloys, and all nickel bearing alloys. Weighted average of price increases is 5.6 per cent.

December 17

▲ Construction contract awards in the 37 states east of the Rockies in November, according to F. W. Dodge Corp., amounted to $1,689,261,000, a decrease of 6 per cent compared with November 1955.

▲ The Bureau of Mines reported that the consumption of scrap during October, 1956, totaled 6,714,000 gross tons and pig iron 6,449,000 gross tons.

▲ The AISI reports that the operating rate of the steel industry for the week of December 17 is scheduled at 102.0 per cent of capacity. This is equivalent to 2,511,000 tons compared with 2,522,000 tons one week ago and 2,338,000 tons one year ago. Index of production for the week is 156.3.

December 18

▲ The Aluminum Assn. reports primary aluminum

production in the United States during November, 1956 was 290,162,159 lb compared with 298,250,683 lb in October 1956 and 267,377,623 lb in November 1955.

▲ Armco Steel Corp. plans to sell more than 1,000,000 additional shares of stock to its stockholders on record on Jan. 9, at the rate of one to ten shares held, to raise $65,000,000.

▲ Phoenix Iron & Steel Co., subsidiary of Barium Steel Co., announced plans to erect a fully-integrated steel mill between Trenton and Camden, on the Delaware, N. J. The first step will be the erection of an 800,000-ingot-ton capacity mill to produce steel by the oxygen-blown method and also coke oven and blast furnaces to make pig iron.

▲ Dominion authorities granted, effective Jan. 1, Canadian railroads a 4 per cent increase in rates.

▲ Major cement producers posted price increases on cement effective January 1, ranging from 15 to 25¢ a barrel.

December 19

▲ Harleston H. Wood, president and chairman of the new voting trustees, Alan Wood Steel Co., said control of the company has been placed in a 10-year voting trust to end rumors on sale of the company.

▲ U. S. Steel Corp. Pittsburgh Steamship division hauled 17,323,000 tons of iron ore during the season ended Dec. 19, 1956, compared with 23,000,000 tons delivered last year. The fall-off in shipments is a result of the 70-day period the vessels were idled by strike.

▲ ARCI reports that deliveries of new domestic freight cars in November totaled 6695 cars compared with 5666 cars in October and 3427 in November 1955. Orders in November totaled 4172 compared with 6532 in October. Backlog of cars on order as of December 1, 1956, stood at 109,370 cars.

▲ National Steel boosts "extras" prices on hot and cold rolled sheet, amounting to less than three per cent increase, joining the several other producers who recently announced like increases.

December 20

▲ The Industrial Heating Equipment Assn. reported that orders for industrial furnaces during November amounted to $3,986,058 compared with $6,180,348 last year.

December 21

▲ Indian Iron & Steel Co. received a $20,000,000 loan from the World Bank.

▲ Workers at U. S. Steel Corp. will receive a 3¢ an hour cost-of-living increase, effective during the first pay period of 1957, resulting from the agreement signed August 3, due to increase in consumer price index for November 15 to 117.8.

December 24

▲ The AISI reports that the operating rate of the steel industry for the week of December 24, is scheduled at 96.3 per cent of capacity. This is equivalent to 2,370,000 tons compared with 2,525,000 tons one week ago and 2,309,000 tons one year ago. Index of production for the week is 147.5.

▲ United Engineering and Foundry Co. announced sales in excess of $60,000,000 in 1956 compared with $47,723,198 in 1955, backlog is in excess of $100,000,000.

▲ Price of copper has been reduced to 33¾¢ a lb, off 1¼¢ to the British industry by Rhodesian Selection Trust, Ltd.; domestic price dropped to the 35-cent a lb level without spurring demand.

December 26

▲ U. S. Steel Export Co. raised export prices 1 to 3¢ a 100 lb on many steel products, ascribing the mark ups to higher rail freight rates in northern Atlantic ports.

December 27

▲ Managements of both companies have agreed on the purchase of Rotary Steel Co., Detroit, by J & L Steel Corp. and deal is pending approval of stockholders. J & L will exchange four of its common shares for each five shares of Rotary Electric.

▲ National Machine Tool Builders Assn. stated shipments of metal-cutting machine tools for 1956 (December estimate) will total approximately $885,000,000 as compared to $670,400,000 for 1955.

▲ Applications for tax help on expansion projects by steel companies, involving $2,300,000,000 were rejected by the government.

▲ William C. Stolk, president of American Can Company stated that metal can production in 1957 will be about 42,000,000 units, compared with 40,000,000 units produced in 1956.

▲ International Tin Study Group's latest statistics show that mine production in 1956 was 163,000 long tons compared with 168,500 long tons in 1955; world (except Chinese and Russian) tin consumption has overtaken production in 1955 and 1956.

December 28

▲ Steelmaking capacity in U. S. increased 5,096,060 tons during 1956 to 133,459,150 net tons annual capacity at January 1, 1957; starting December 31 the new weekly capacity is 2,559,490 net tons instead of 2,461,758 tons weekly capacity at the start of 1956.

▲ Latin American countries present use of steel is 6,600,000 tons annually, imports amounted to 62 per cent during 1956. Steelmaking capacity, however, is now 3,400,000; programs underway will raise the total to 6,400,000 tons by 1960.

▲ Oil use in the U. S. in 1956 exceeded 1955 by 51½ per cent and Eugene Holman, chairman Standard Oil Co. of New Jersey announced an expected additional 4 per cent increase is in sight for 1957.

▲ Charles L. Huston, Jr., president Lukens Steel Co., reports the company hopes to finance its $40,000,000 expansion program with loans from its customers and disclosed that a commitment of $15,000,000 has been made by G.E.

▲ Auto production for 1956 totaled 5,810,183 cars, 26.8 per cent short of the 7,939,968 cars produced in 1955.

▲ Frank W. Glaser, executive vice president and general manager, Alloy Precision Castings Company, announced that sales of the investment casting industry are estimated at $160,000,000 for 1956, compared with $135,000,000 in 1955.

December 31

▲ The AISI reports that the operating rate of the steel industry for the week of December 31 is scheduled at 98.0 (based on 1957 annual capacity of 133,459,150 net tons) per cent of capacity. This is equivalent to 2,509,000 tons compared with 2,322,000 tons one week ago and 2,403,000 tons one year ago. Index of production for the week is 156.2.

STEEL MEN!

WHY PAY MORE THAN $12 PER TON FOR FLUX BLOCKS?

ORIGINALLY, glass tanks were built of small, fire-clay brick or sandstone blocks. No. 1 fire-brick of this type can be bought for $12 per ton. Clay flux blocks of essentially the same materials cost $60 per ton. Why pay a 500% premium simply to get *bigger pieces* of the same material?

Your reply, of course, is that the larger pieces improve furnace life by 40% to 50%—that you are willing to pay 500% more for your blocks, to get 50% greater life for your tanks. And that is true of every glass-tank owner in America today. Since you are already paying a 500% premium for a 50% return, *why is it not logical for you to buy Corhart Electrocast, at a smaller price premium over clay,* AND GET OVER 200% INCREASE IN FURNACE LIFE?

If you are looking for economy in the purchase of your tank blocks, you need pay only $12 per ton. On the other hand, if you want the lowest cost per day of tank life, or the lowest cost per ton of glass produced, you can not stop at the $12 block *or at the $60 block.*

Corhart Electrocast is the world's highest-priced refractory per ton of blocks, and the lowest-cost refractory per ton of glass produced . . . May we *prove* it to you? Write for definite facts. *Address:* Corhart Refractories Co., *Incorporated,* 16th and Lee Sts., Louisville, Ky.

CORHART ELECTROCAST REFRACTORIES

IN June, 1933, when this old ad appeared, Corhart Electrocast was still new in the glass industry. Only a few glass companies dared then to buy it, "one of the world's highest-priced refractories". But today its use is practically universal . . .

Now Corhart 104 is still new in the steel industry — but despite its high price, it offers steel furnace operators the same opportunities for greater production and lower costs that Corhart Electrocast brought to glass.

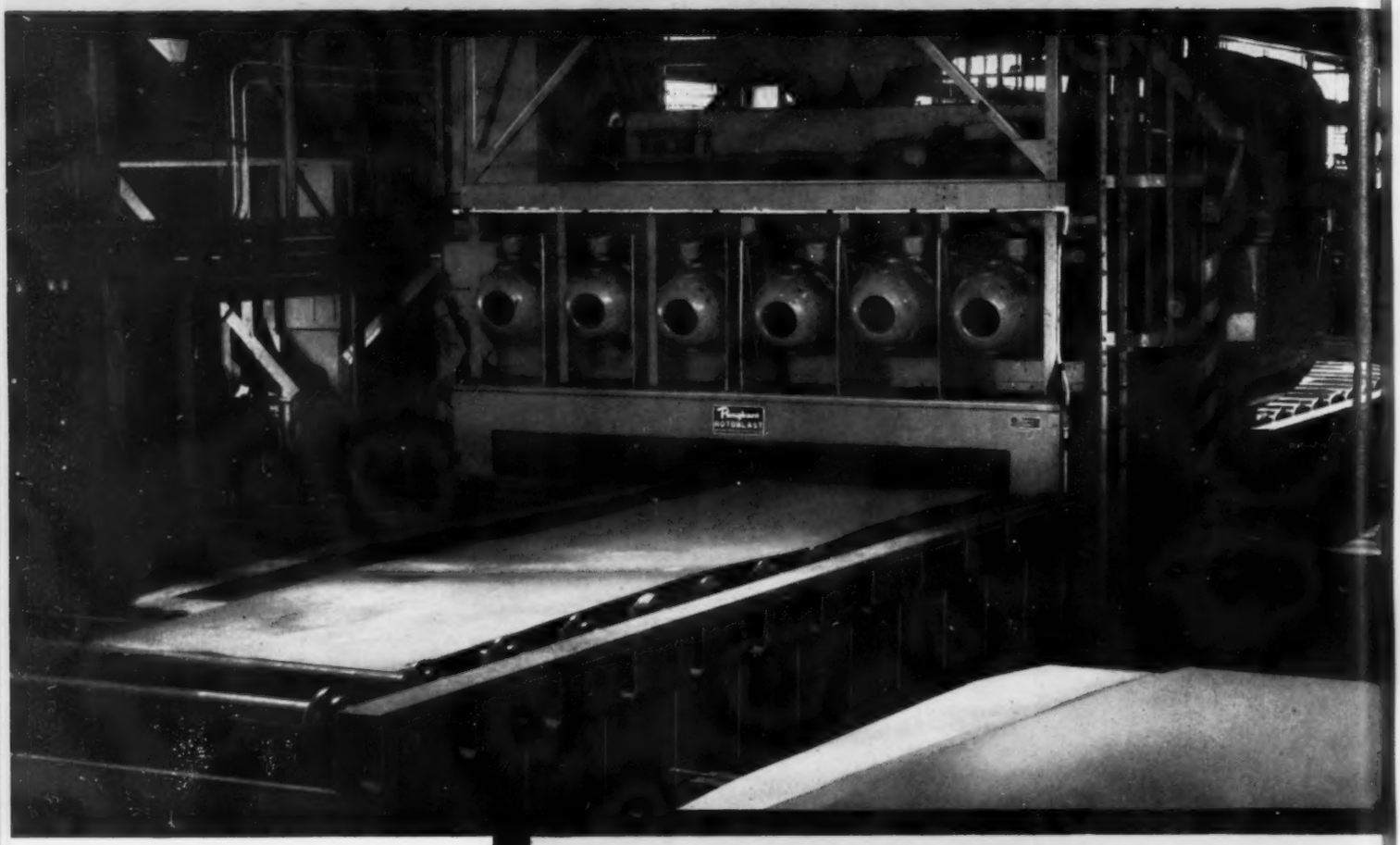
May we send you complete data? Address: Corhart Refractories Co., Incorporated, 1614 West Lee Street, Louisville, Kentucky, U.S.A., SPring 8-4471.

QUALITY ECONOMY ENDURANCE

CORHART 104 ELECTROCAST REFRACTORY

The words "Corhart" and "Electrocast" are registered Trade Marks which indicate manufacture by Corhart Refractories Company, *Incorporated.* Corhart Refractories Co., *Incorporated,* 1600 West Lee Street, Louisville 10, Kentucky, U.S.A.—Telephone SPring 8-4471.

Descale steel sheets, plates, coils



at *less than half the cost*

No more scale breaking or pickling! No more acid disposal problems! Pangborn Rotoblast Descaling Machines descale steel sheets, plates and coils, and they operate at big savings over pickling costs!

How? They work quickly. They clean thoroughly. They're a one-man operation. Unlike acid baths, they can be located near your production, cutting handling costs. And they save floor space, require much less room than vats. Available in a variety of models, Pangborn Rotoblast Descaling Machines handle steel sheets, plates and coils of any thickness, width and length. If you want to cut descaling costs to the bone, investigate Pangborn Descaling Machines!

For complete information, send for Bulletin 608. Write: PANGBORN CORPORATION, 4400 Pangborn Blvd., Hagerstown, Maryland.

*U. S. Pat. # 2184926 (other patents pending)

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Special Blast Rooms & Cabinets

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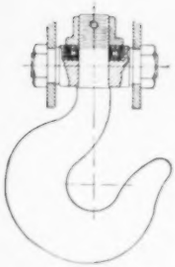
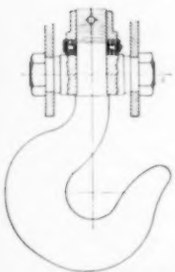
Distributors for Malleabrasive and Tru-Steel Abrasives

New bulletin shows latest R.B.E.C.* tables for crane hook bearings . . .



Rollway Type CT
Crane Hook
Thrust Bearing



Rollway Type WCT
Crane Hook
Thrust Bearing

Reflecting the newest standards for the selection of crane hook bearings, the tables contained in this Rollway bulletin are founded on *basic static load ratings*.

This approach takes into account the ability of Rollway-built rollers and plates to recover from temporary deformation due to static loading, as soon as the bearing starts to rotate.

Actual bearing capacities of Rollway Crane Hook Bearings are *higher* than those given in the tables, because in most crane-hook applications the bearing is operating under slow speed conditions.

Crowned Rollers Provide Even Load Distribution

The crowned rollers used in Rollway Crane Hook Bearings eliminate the harmful effects of corner loading of rollers. Weight is distributed evenly along the full line of contact between roller and plate. Starting torque is reduced by as much as 25% as compared to straight rollers!

* Roller Bearing Engineers' Committee of the Anti-Friction Bearing Manufacturers' Association

Rollube Retainer Resists Wear

All Rollway Crane Hook Bearings feature the new Rollube Retainer, made of ferrous material with corrosion resistant finish. Wear properties are excellent even under adverse lubricant conditions.

• For full information on the R.B.E.C. tables and Rollway Crane Hook Bearings, send coupon below.

ROLLWAY®
BEARINGS
COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

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569 Seymour St., Syracuse, N. Y.
Please send your "Crane Hook" Bulletin No. 956.

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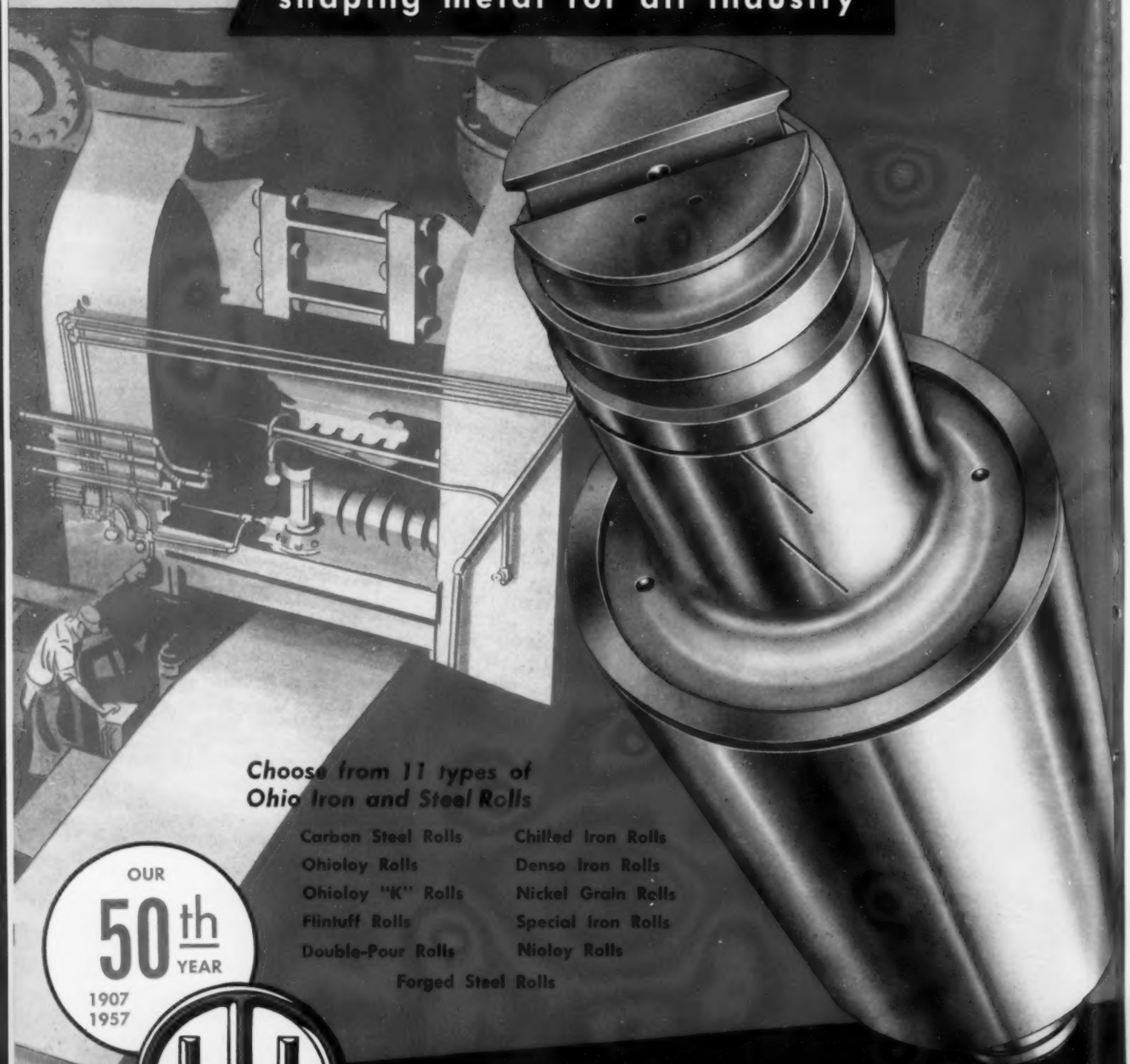
shaping metal for all industry



Choose from 11 types of Ohio Iron and Steel Rolls

Carbon Steel Rolls	Chilled Iron Rolls
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Flintuff Rolls	Special Iron Rolls
Double-Pour Rolls	Nioloy Rolls
Forged Steel Rolls	

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LIMA, OHIO

Plants at Lima and Springfield, Ohio

OHIO

Industry News...

REACH AGREEMENT ON ACQUISITION OF ROTARY ELECTRIC STEEL CO. BY JONES & LAUGHLIN

▲Admiral Ben Moreell, chairman of the board of Jones & Laughlin Steel Corp. and J. A. W. Iglehart, chairman of the board of Rotary Electric Steel Co. announced that agreement has been reached by their respective boards of directors for the acquisition of the Rotary business by J&L.

The agreement is subject to ratification by the shareholders of Rotary and also to the approval of an increase in authorized shares by the shareholders of J&L. It provides for J&L's acquiring all the assets and assuming all the liabilities of Rotary. The purchase price would be J&L common stock sufficient to provide four shares of J&L for each five shares of Rotary.

Mr. Iglehart, Rotary's chairman, will be elected to the Board of Directors of J&L.

The acquisition of Rotary's business will mark the entrance by J&L into the stainless steel industry, with production facilities in the important Detroit, Mich., area.

The Rotary plant in Detroit is a producer of stainless, alloy and special grade ingots, slabs, billets, hot rolled and cold finished bars, rods and wire. J&L earlier this year announced its consideration of installing the necessary equipment and entering into production of stainless steel sheets and strip products. It is now the intention of J&L to carry out this plan, integrating it into the present plant and operations of Rotary in Detroit.

The entire enlarged stainless steel business will be operated and managed from the present Rotary headquarters in Detroit under the present Rotary management.

Rotary produced in 1955 about 10 per cent of all the stainless steel produced in the U. S.; and in that year stainless sales constituted 73 per cent of its total dollar sales.

Rotary has carried out an extensive program of plant additions and improvements in recent years. This program has resulted in substantial changes in its product pattern. An increasing proportion of all products has been sold in the form of billets, bars and wire as against a previous larger concentration on ingots and slabs. This trend toward finished mill products would be further emphasized as a result of the stainless flat rolled program which is planned in connection with the acquisition by J&L.

TUBE MILL EXPANSION COMPLETED AT TIMKEN

▲The Timken Roller Bearing Co's. Steel and Tube Division recently completed a million and a quarter expansion program of its tube mill when its renovated and modernized number two piercing mill resumed operations. Now capable of producing alloy seamless tubing 40 ft in length, weighing up to 3500 lb, the modernized tube mill will help meet the growing demand for heavy wall seamless tubing from the country's oil industry.

A storage building, a rotary sizing mill, cooling and reheat furnaces, and installation of industrial television control systems for regulating the flow of tubing into various furnaces and cooling units, were part of the tube mill expansion program. Enlarging and rebuilding of inlet and outlet tables for the piercing mill, the reelers and the return mill was also necessary before the longer tubes could be handled.

Three control pulpits, part of the system to control flow of tubing through the tube mill, were rebuilt and equipped with clear vision cabs and air conditioning units. The pulpits are connected by an intercommunications system.

The hot annealing furnace, a new chain type, is equipped with automatic temperature controls. Scales, used to weigh the finished tube, are located at the end of the furnace.

ANNOUNCES EXPANSION IN PITTSBURGH DISTRICT

▲ Placing of contracts for construction and improvement of facilities to add about 670,000 ingot tons to the steelmaking capacity of United States Steel Corp.'s Pittsburgh District plants has been authorized, according to an announcement made by Harvey B. Jordan, executive vice-president—operations.

These projects will raise the annual capacity of U. S. Steel's Monongahela valley plants to about 11,910,000 tons.

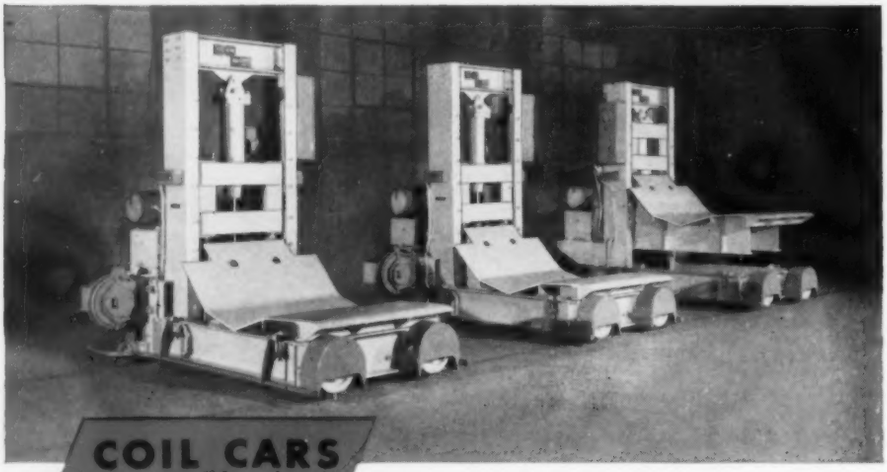
Expansion of existing open hearth

INSPECT GIANT PLATE FOR ATOMIC REACTOR

Albert Fulton, metallurgist, and Herb Beck, a supervisor, are inspecting the heaviest and one of the largest stainless steel plates ever sold by Allegheny Ludlum Steel Corp. The plate is 84 in. wide, 340 in. long and 3⅛ in. thick and is to be used at Shippingport, Pa., in the first full scale atomic power plant in America. The finished plate weighs 25,275 lb and will eventually be the core cage barrel which encloses the reactor.

HERR EQUIPMENT

"Complete Processing and Handling Equipment . . . for any Ferrous or Non-Ferrous Material . . . That Starts — or Ends — as a Coil"



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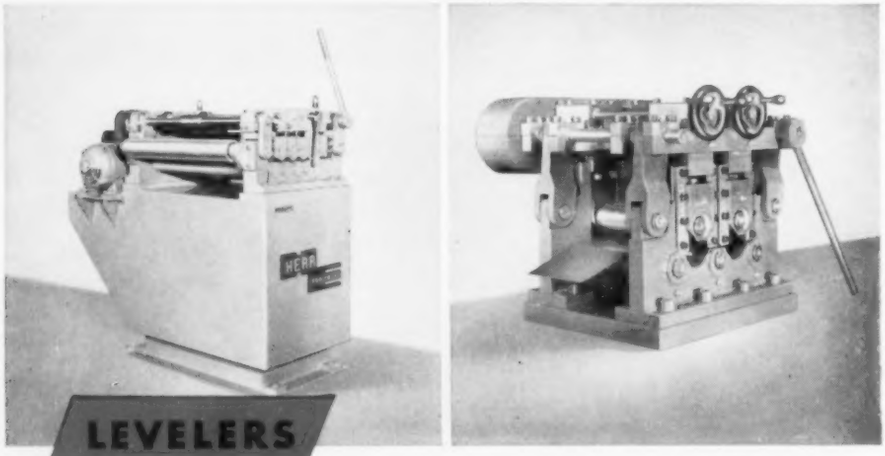
For fast, efficient loading of pay-off reels and unloading of coiling reels. Sizes to handle coils of any diameter, width or weight. Hydraulic lift, electric traverse. No pits. Can be fitted with coil ejector, up-ender and other accessories if desired. Furnished complete ready for use.



LEVELERS

2-High and 4-High types. Driven and pull-through designs with quick release, for handling an extremely wide range of materials, widths and gauges. Rolls can be rubber covered if desired for easier adjustment and handling high finished materials.

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THE HERR EQUIPMENT CORPORATION

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CLEVELAND, INDIANAPOLIS AND BERKELEY, CALIFORNIA

and electric furnace capacity, together with installation of finishing facilities, will provide approximately 450,000 tons of plates, structural steel, forgings and other products.

Improvements to present open hearth furnaces and provision of further handling facilities will permit efficient utilization of the additional iron being made available through the construction now under way of sintering facilities at Saxonburg, Pa., and will increase open-hearth capacity by approximately 365,000 tons at Homestead Works, 90,000 tons at Duquesne Works, and 120,000 tons at Edgar Thomson Works, for a total of about 575,000 ingot tons. Capacity for converting these ingots into plates and structural steel will be obtained by improvements to finishing facilities at Homestead.

Also, 95,000 tons of added electric furnace ingot capacity will be provided at Duquesne.

Additional forging and heat training facilities at Homestead will permit processing the electric furnace ingots into forgings and other steel products suitable for these applications.

Work on the new facilities and improvements is expected to get under way early in 1957.

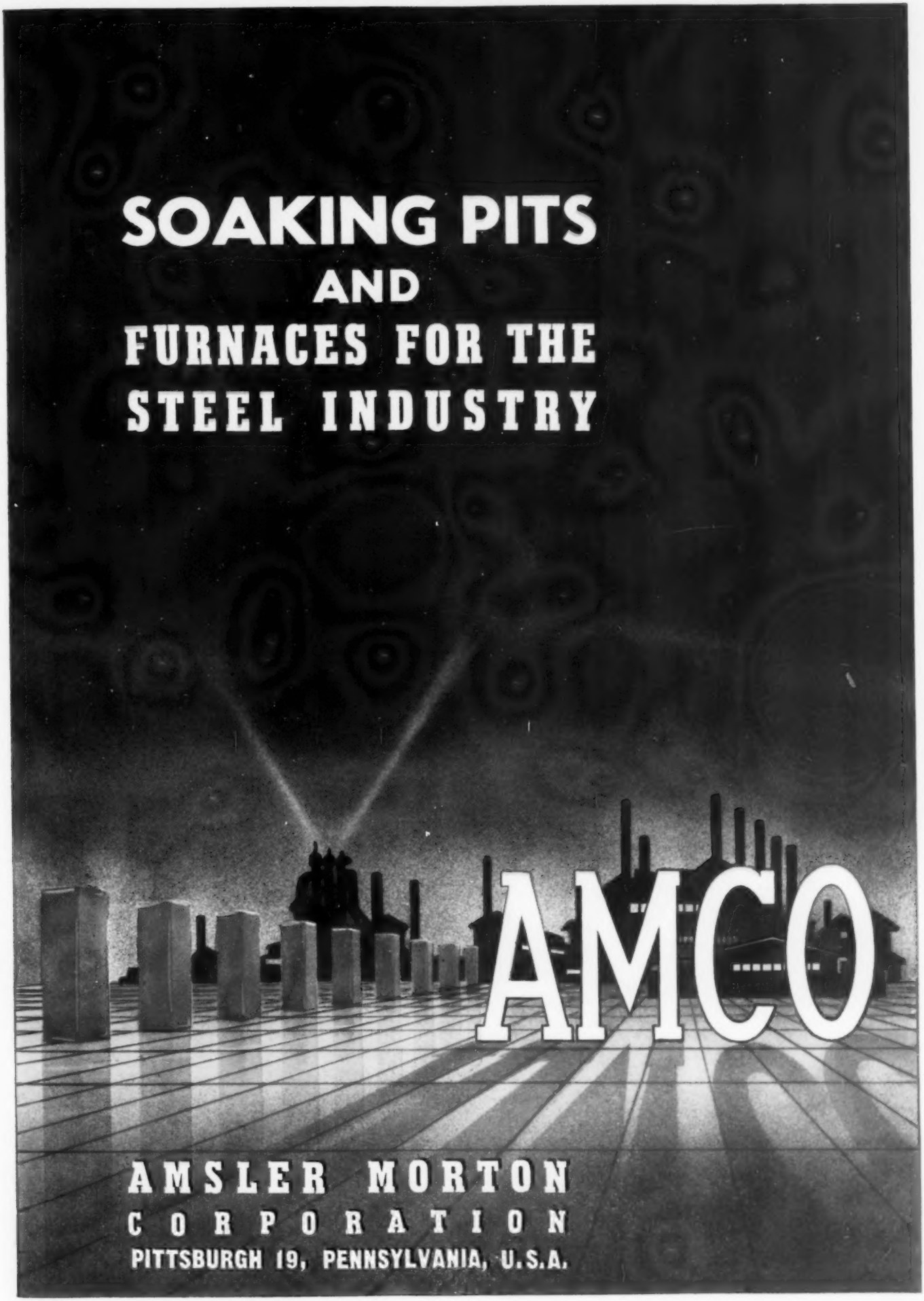
FIRM APPOINTS WEST COAST REPRESENTATIVES

▲The Youngstown Foundry & Machine Co. announce the following appointments of manufacturers representatives to serve the steel industry with rolling mill rolls and equipment for the Far West: R. J. Myers, 755 W. 9th St., Claremont, Calif., and Donald Loeser, 2000 Solveig Drive, Walnut Creek, Calif.

TITANIUM FIRM TO BUILD SCRAP REFINING PLANT

▲Mallory-Sharon Titanium Corp. has announced plans for construction of a large-scale pilot plant for refining titanium scrap, using a new electrolytic process that yields extremely pure metallic titanium. The plant's refining capacity will be large enough to permit complete evaluation of the new process.

Since the beginning of the titanium industry, re-use of scrap has presented a problem. Presently scrap


SOAKING PITS
AND
FURNACES FOR THE
STEEL INDUSTRY
AMCO
AMSLER MORTON
CORPORATION
PITTSBURGH 19, PENNSYLVANIA, U.S.A.

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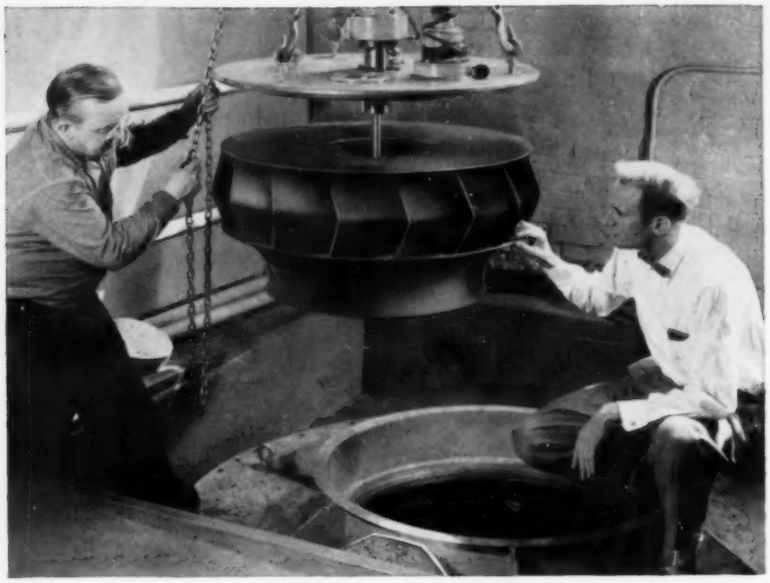
COMPLETE "BUFFALO" TESTING FACILITIES GIVE YOU THE LATEST AND BEST IN FANS

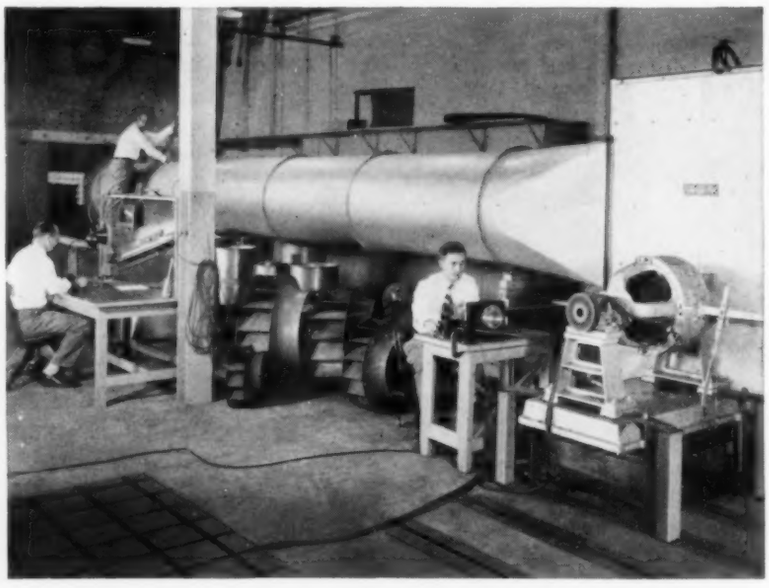
Such comprehensive testing — coupled with the fanmanship we've developed in 80 years — is your assurance of the "Q" Factor* in every "Buffalo" centrifugal, axial flow and propeller fan you order.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



For greatest wheel strength, every wheel design must be tested at many times its operating speed. This is possible only in the "Buffalo" Vacuum Test Pit, where we literally spin wheels to destruction — discovering any weakness and correcting it. Thus, the "Buffalo" fans delivered to you have wheels capable of withstanding centrifugal force stresses far in excess of normal installed operation.

Performance tests. Continual testing of wheel and housing designs for noise and efficiency, from free air delivery to shutoff, result in ever-improved performance. All tests in the complete "Buffalo" laboratory are in strict accordance with ASH&VE, NAFM and PFMA test codes.



"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

must be carefullly segregated, cleaned, and processed, and oxygen or nitrogen contamination cannot be tolerated in view of strict quality requirements. Although titanium producers are melting some scrap in their operations, technical difficulties limit its usability.

As a result, there has never been a market for titanium scrap comparable to that for other metals. If the new process proves as attractive as it now appears, this scrap situation, affecting the entire titanium industry, will be radically changed.

According to James A. Roemer, Mallory-Sharon President, the process has been proved on a laboratory scale and several hundred pounds of ductile titanium have been produced. One of the main features of the process is that scrap quality appears unimportant, and many grades of scrap can be easily refined. The end product of the process consists of large crystals of extremely pure metal, formed on a steel cathode in a heated electrolytic solution. After refining, the crystals will be used in Mallory-Sharon's double-melting process in the production of conventional large ingots.

Indicative of the high purity obtained, electrolytic metal with a Brinel hardness of 60 has been made, whereas present commercial titanium has hardness of 120 to 140. Elongations as high as 60 per cent have been achieved. This high purity may well lead to new uses for the metal, but in any event will simplify processing.

The basic refining method known as the Dean-Raney Process, was developed by Dr. R. S. Dean and Dr. Ben B. Raney, and laboratory work was handled at the Chicago Development Corp. under sponsorship of Mallory-Sharon. Dr. Dean, one of the pioneers in the titanium field with the Bureau of Mines, has served as consultant to Mallory-Sharon since 1952, concentrating on development of the electrolytic refining process.

PORTER CO. TO BUILD MISS. CHEMICAL PLANT

▲H. K. Porter Co., Inc., plans to build a chemical plant in Pascagoula, Miss., to produce magnesia and basic refractory products. Completion is scheduled for early 1958.

The plant will be located on a 400-acre tract on the proposed new deepwater channel currently being constructed by the Jackson County Port Authority of Pascagoula. The new channel will provide docks and access to oceangoing vessels drawing up to 32 ft.

The location was chosen because of the ready availability of raw materials, natural gas, and rail and water transportation which will permit economical shipment of the material to the principal markets for basic refractory materials in Birmingham, Chicago and Pittsburgh. Pascagoula is located on Mississippi's Gulf Coast.

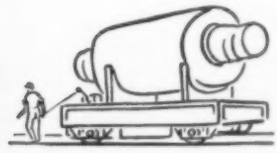
ALLIS-CHALMERS EXPANDS AT ST. THOMAS WORKS

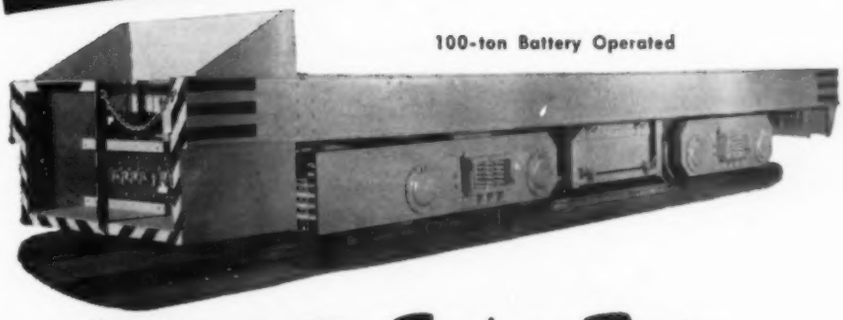
▲Construction has started on a 17,000-sq ft addition to the St. Thomas Works of Canadian Allis-Chalmers Ltd.

J. A. McVeigh, works manager, said the addition will increase production facilities to meet a rise in

(*Please turn to page 199*)

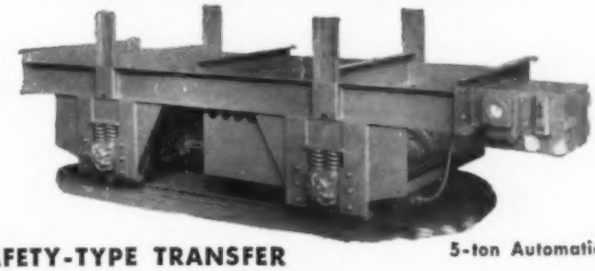
HANDLES THE BIG LOADS WITH BIG SAVINGS





100-ton Battery Operated

ATLAS *Safety Type* TRANSFERS



5-ton Automatic Controlled

ATLAS SAFETY-TYPE TRANSFER CARS can be provided in almost any capacity for storage battery, diesel or gas-electric, or cable reel service.

They are safe because there is only one control lever, and the car moves only when the operator holds the lever.

Request "Walk-Along" Bulletin 1283.

ATLAS CAR & MFG. CO.
1100 IVANHOE ROAD
CLEVELAND 10, OHIO

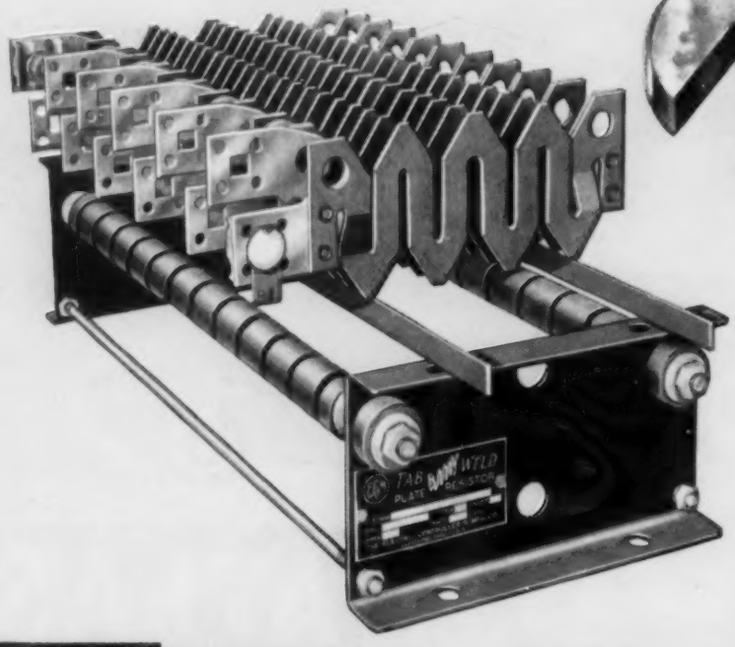
ENGINEERS AND MANUFACTURERS SINCE 1896

HANDS OFF!

EC&M TAB-WELD RESISTORS REQUIRE *MINIMUM* MAINTENANCE

Only EC&M TAB-WELD PLATE RESISTORS are both bolted and welded for constant current path. Unlike other resistors, they do not require periodic tightening of clamping nuts to compensate for loss of pressure caused by alternate heating and cooling. Grids are offset and mating ends are spot welded. Tap-plates are also welded into place at close intervals along the grid assembly.

This exclusive EC&M construction offers 4 big advantages on heavy duty motor applications: (1) stabilized ohmic value (2) no burning at grid-eyes or at tap-plates (3) easy tap-shifting for best motor performance and (4) long life with virtually no maintenance!



FEATURES THAT REALLY COUNT!

- Nonbreakable
- Corrosion-resistant alloy steel
- Negligible resistance change between cold and maximum working temperatures
- Offset resistor ends spot-welded
- No burning at grid-eyes
- No burning at taps
- Small adjustments in resistance value easily made
- Insulating spacers remain dimensionally stable
- No periodic tightening of clamping nuts
- All standard sections same size
- Double insulation to ground
- Fast connection to any tap-plate

Write for illustrated Bulletin No. 942-B
Complete data on EC&M TAB-WELD RESISTORS

SQUARE D COMPANY
EC&M DIVISION • CLEVELAND 28, OHIO

7404

CONTINENTAL

LEWIS

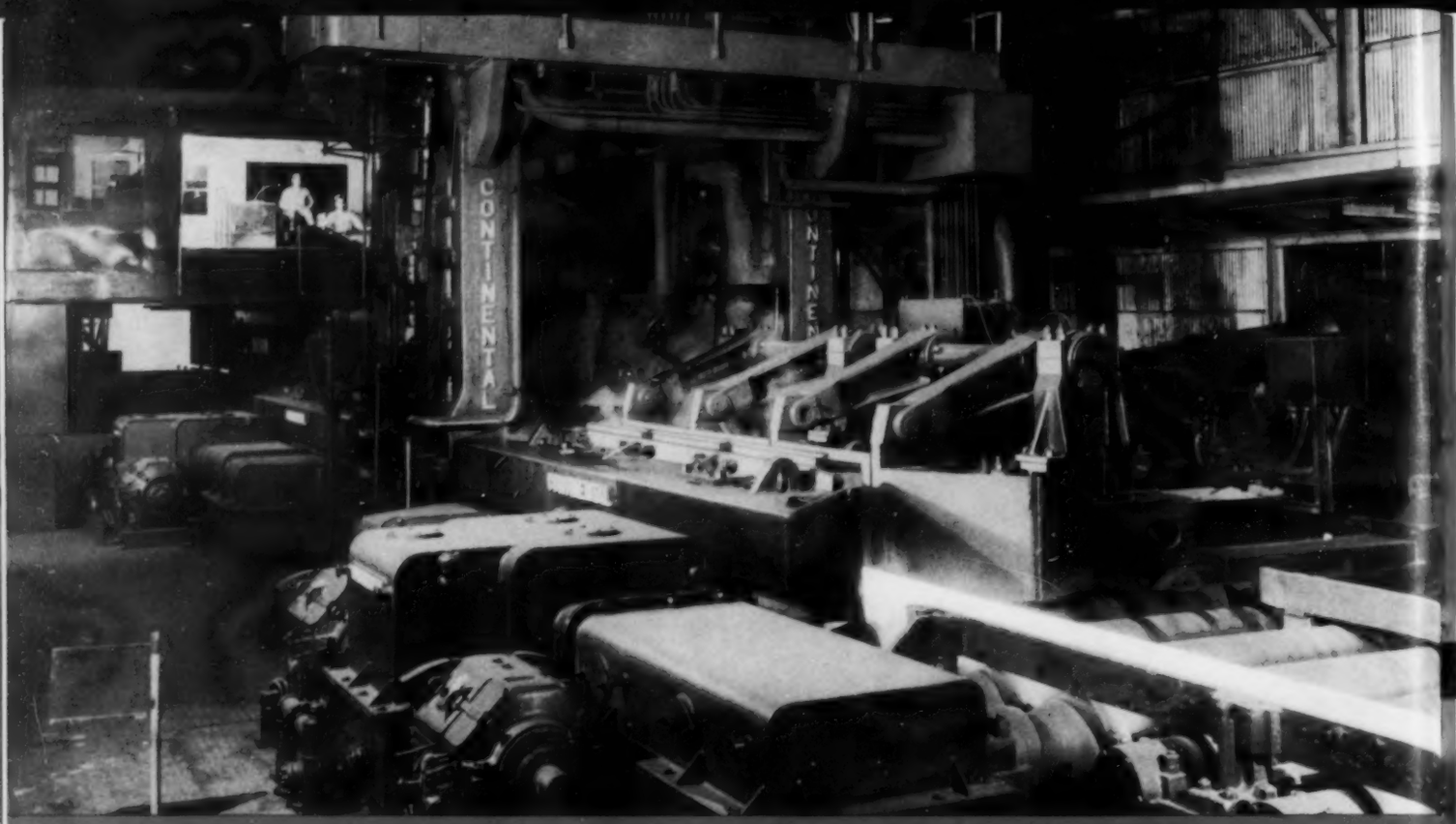
MEDART

BLAW-KNOX

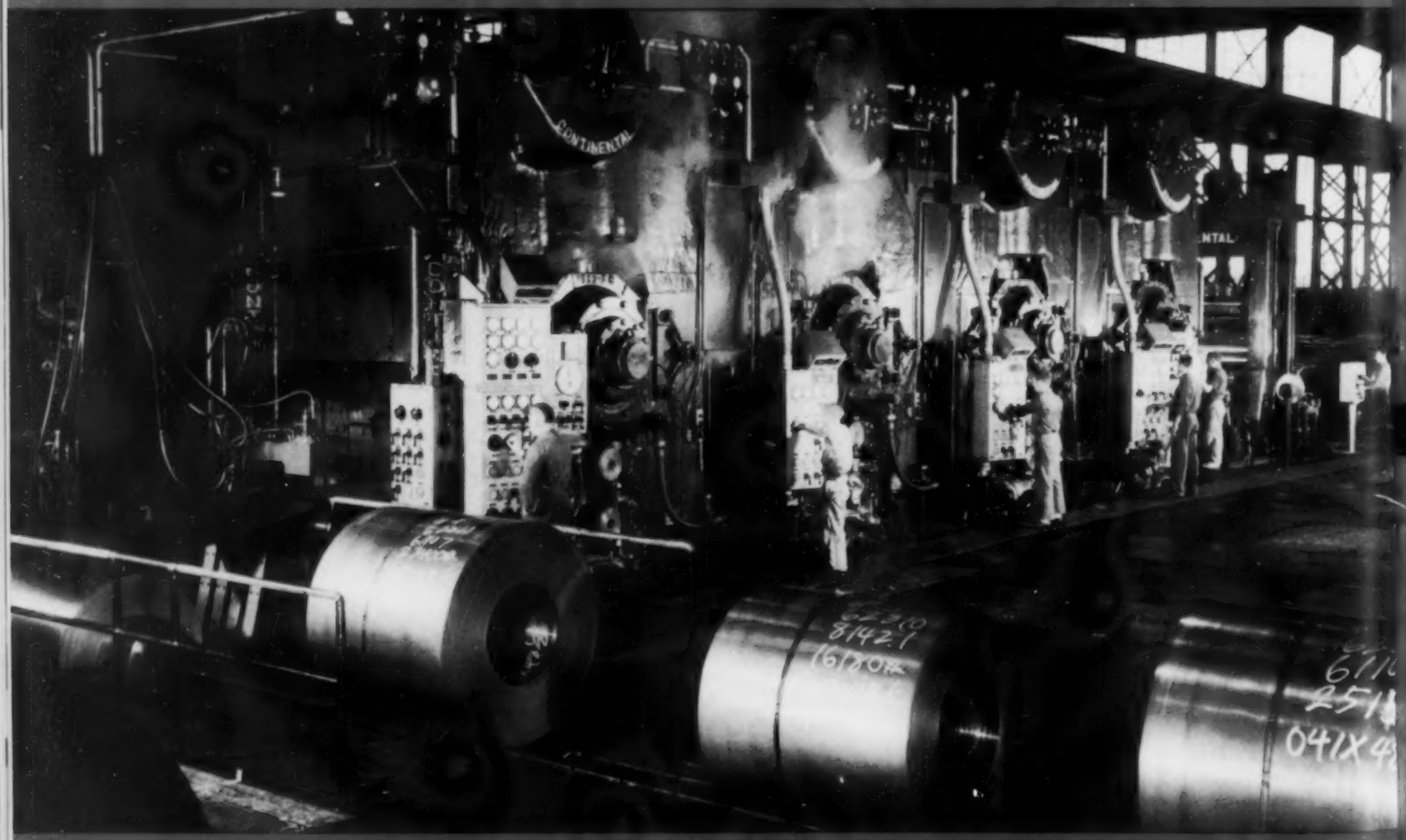
headquarters for the best-named products serving the metals industry!

Grouped under the Blaw-Knox Foundry and Mill Machinery banner are the best known names in Metal Producing and Metalworking production equipment. These products, custom-designed and built for the highest standards of performance include: complete primary and finishing rolling mills, a comprehensive line of standard and special grade rolls, cold finishing equipment, castings for steelmaking, special high temperature alloy castings for heat treating and water cooled equipment for open hearth furnaces.

Behind each of these products is an engineering force and plant capacity that has no equal in industry. You can expect exceptional service from this integrated organization of machines and men who understand your production and market problems.



BLOOMING MILL—40-inch, 2-high reversing blooming-slabbing mill



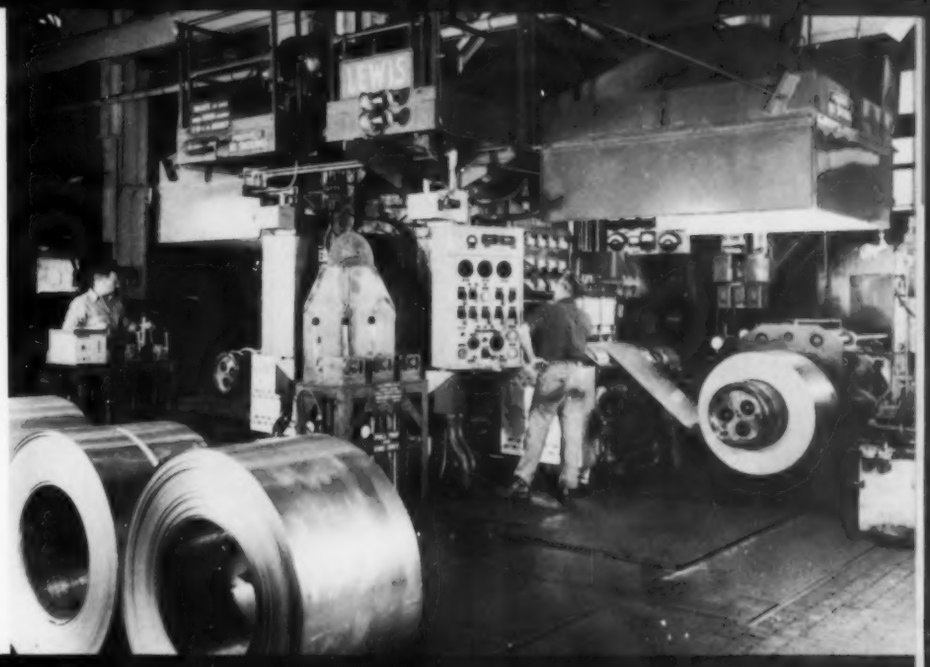
COLD MILL—High-speed 21" x 53" x 60", 4-stand tandem cold mill

Continental

In addition to complete mills for rolling all types of ferrous and non-ferrous metals, Blaw-Knox offers design, construction engineering, erecting and installation of the mill together with auxiliary equipment and special machinery. Thus you are assured of a single responsibility from preliminary engineering to satisfactory installation.

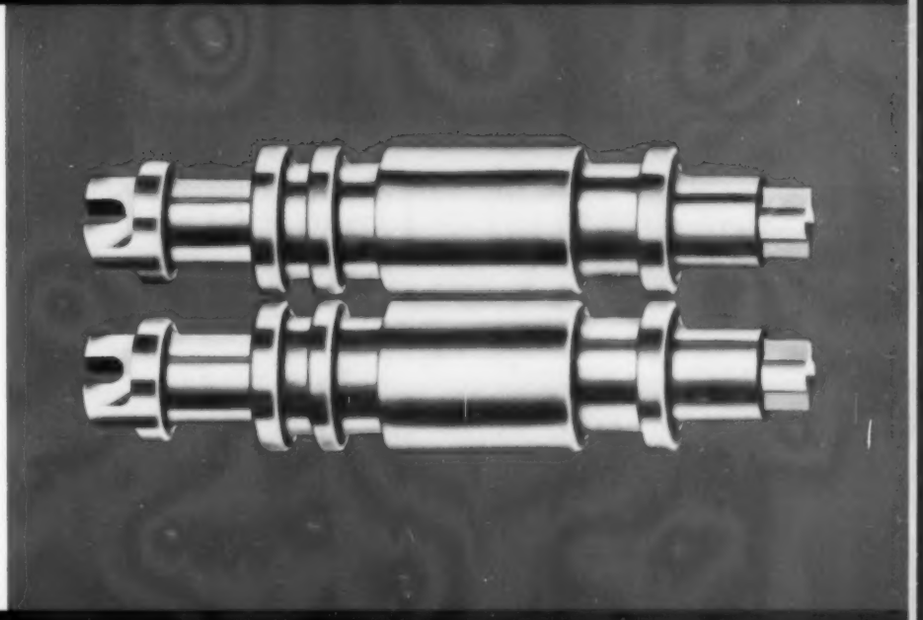
Lewis

Lewis four-high reversing cold mills for rolling thin metals provide built-in versatility combined with continuous control and high speed delivery. Representative of the line, this four-high reversing unit for the cold reduction of strip aluminum and copper-base alloys.



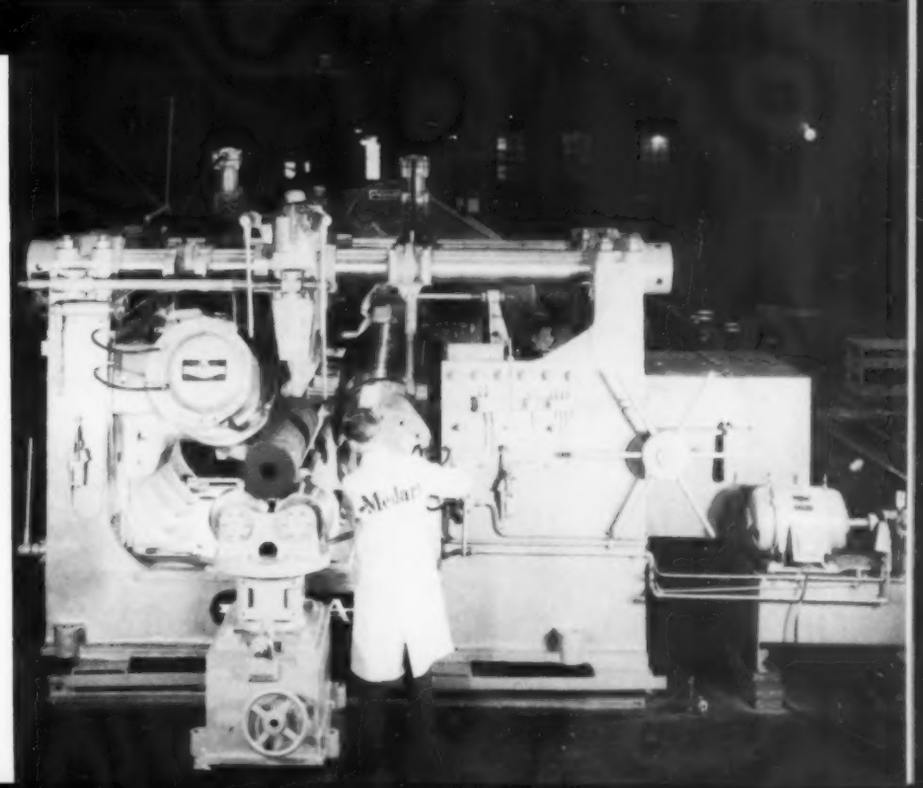
Rolls

More than 50 different grades of iron and steel rolls are regularly available from Blaw-Knox. These rolls bear such well known trade names as Continental, Lewis and Pittsburgh. In addition, Blaw-Knox roll engineers can recommend special types of rolls best suited to your requirements.



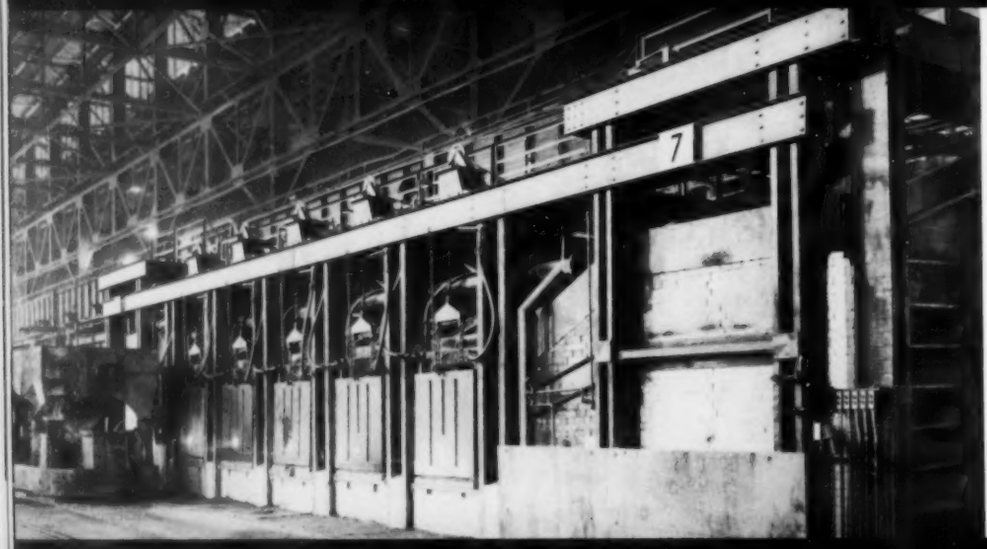
Medart

The most advanced and complete line of cold finishing equipment in industry. Shown here is one of the most widely used Medart machines, the 2-roll rotary straightening, sizing and polishing machine. To meet your special requirements, there's a Medart machine for billet peeling and chipping, sizing and polishing, centerless turning, straightening and roll grinding.



Castings

Blaw-Knox castings are in service in practically every segment of American Industry. Under the famous trade names, Union and Continental, their quality reflects a program of constant improvement and the use of the most modern Foundry techniques. Blaw-Knox engineers are ready to study your designs in order to provide the best casting at the lowest practical cost.



Steel Plant Equipment

Blaw-Knox water cooled equipment for use with high temperature furnaces provides a high degree of operational safety in rugged steel making operations. In addition, Blaw-Knox provides equipment such as dolomite machines, autopours, reversing valves and ladle addition feeders for use in mechanized steelmaking operations.

National Alloy

The problems of heat and corrosion have been successfully overcome throughout the metals industry with the use of National Alloy castings. The advanced metallurgical skills and production facilities of National Alloy are directed to the single goal of providing high alloy castings for maximum service under the severe operating requirements imposed by elevated temperatures and corrosive conditions.

BLAW-KNOX

BLAW-KNOX COMPANY

300 Sixth Avenue

Pittsburgh 22, Pennsylvania

(*Continued from page 193*)

demand for products manufactured at the St. Thomas Works. The plant produces diesel locomotive controls, electric motors, high voltage starters and switchgear controls for diesel engine-generators.

The plant addition is expected to be completed by March, 1957.

TO DISTRIBUTE REYNOLDS ALUMINUM IN CLEVELAND

▲Appointment of the Hamilton Steel Warehouse of the Jones & Laughlin Steel Warehouse Division as a distributor of Reynolds Aluminum mill products has been announced jointly by Reynolds Metals Company and Jones & Laughlin Steel Corp.

The appointment will increase the availability of industrial aluminum products in the Cleveland marketing area. Items in stock for immediate shipment include flat and coil sheet, rods, bars, structurals, angles, tubing, plates, and architectural shapes.

CHANGE OF FIRM NAME ANNOUNCED BY HAGAN

▲Hagan Corp. has changed its name to Hagan Chemicals & Controls, Inc. At the same time its subsidiaries, Calgon, Inc., Hall Laboratories, Inc., and The Buromin Company will be merged into the parent company. Calgon and Hall will continue as divisions.

In announcing the change, W. W. Hopwood, Hagan president, said that the new name will better describe the company's activities in the fields of chemical engineering and automatic control equipment.

NATIONAL ROLL INITIATES IMPROVEMENT PROGRAM

▲ Delivery of a new quarter-million dollar roll grinding machine to the National Roll and Foundry Division of General Steel Castings Corp., at Avonmore, Pa., in early 1957 will mark the completion of the first phase of a major plant rehabilitation and capital improvement program at Avonmore. National Roll became an operating division of General Steel on January 1.

The grinder, manufactured by the Mesta Machine Co., will be of the traveling table type and will be equipped with the most modern

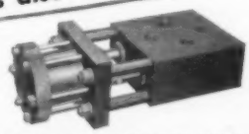
INEXPENSIVE—HIGHLY EFFICIENT

UNEQUALED FOR ⅛" AND ¼" SERVICE

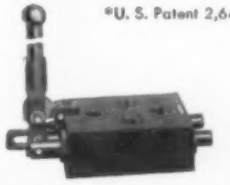
• These valves combine utmost simplicity, low price and rugged, efficient, dependable construction. Valve chambers* are formed by aluminum spacers held tightly in metal to metal end abutment assuring accurate positioning of the "O" rings on both inside and outside diameters without mechanical pressure. The flow is from the inlet chamber through the hollow radially ported ground and polished stainless steel plunger, and out through other ports in the plunger to the connected line. No direct impingement of flow across the packings. No lapped joints. No metal to metal seating. Sub-base permits ⅛" or ¼" pipe connections into either side or bottom. Easily serviced in the field. Write for fully descriptive bulletin.

*U. S. Patent 2,645,450

Ask us also about . . .



PILOT CYLINDER OPERATED HYDRAULIC VALVES suited for use with water or hydraulic oils up to 5,000 psi. 2-way, 3-way and 4-way actions. Sizes ½" through 4".



LEVER OPERATED HYDRAULIC VALVES suited for use with water or hydraulic oils up to 5,000 psi. 2-way, 3-way and 4-way actions. Sizes ½" through 1½".

Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1924 East Pershing St., Salem, Ohio

automatic controls and safety devices. It will accommodate rolls up to 60 in. in diameter and 24 ft in length.

Details of the plant improvements include a new lathe and overhauling of other machinery in the roll shop, structural steel framing in the roll shop and moving to Avonmore of a double-unit tandem post mill from General Steel's Granite City, Ill., plant. In the iron foundry, a new sand loader has been installed, the two 30-ton overhead cranes have been overhauled and modernized, new floors and walkways built and a new pouring pit installed. In the steel foundry, the old open hearth furnace has been removed entirely, and installation of a second electric furnace has been completed. New transformer and sub-station equipment has been installed to modernize the electrical facilities. An existing stationary sand-slinger has been converted to a motive machine, and the molding area relocated. Other improvements in the steel foundry include new shake-out equipment and a new hydraulic press.

POWER PLANT TO FEATURE COMBINED TURBINE UNITS

▲ The first power plant in the United States to be planned as a combined gas turbine-steam turbine generator unit will be built in Cordele, Ga., by the Crisp County Power Commission.

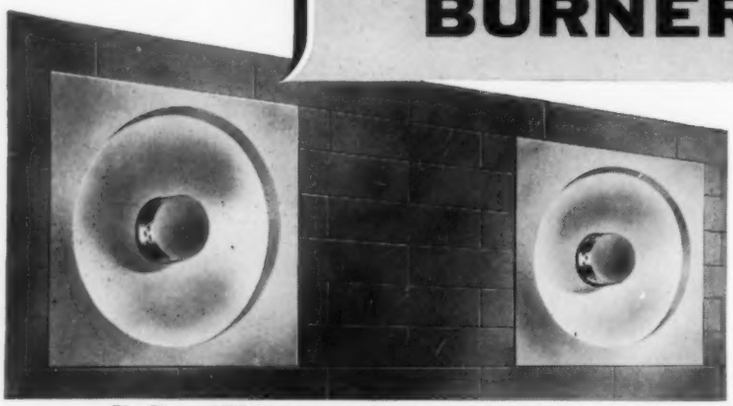
In the new unit, exhaust from a gas turbine will flow into a steam boiler where, in combination with pulverized coal, it will produce steam for a steam turbine. Although several other power stations are using gas turbines to improve efficiency of steam turbines, the Crisp County installation will be the first specifically designed and engineered to combine a gas turbine and steam turbine unit. Both the gas and the steam turbine-generators will be built by the General Electric Co.

In the new plant, a 5,000 kilowatt simple-cycle, single-shaft gas turbine will exhaust into a steam boiler to develop 600 lb of 825 F total temperature steam for a 12,500 kilowatt steam turbine-generator. Thus, the maximum capability of the combined cycle is estimated at 17,500 kilowatts.

Pulverized coal will provide supplementary firing in the boiler to provide additional steam, including necessary superheat when required by the steam turbine, over that generated by the gas turbine to the capacity of the steam turbine, including necessary superheat.

for intense concentration of heat...

The BLOOM HTR BURNER



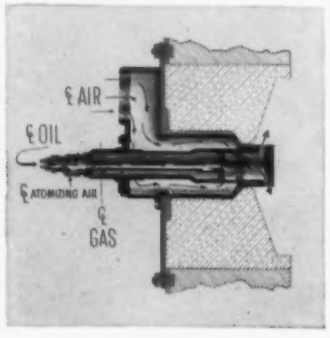
The Bloom HTR Burner provides identical operation on either gas or oil.

This burner enables the engineer to design a heat pattern with excellent results, because it has the unique characteristic of providing localized high heat release with low forward velocity. The burner can be located to fire directly at the material without flame impingement. Roof firing is easily accomplished and provides uniform hearth temperature.

This burner has been very successful in its application to tube upset furnaces; continuous strip annealing, coating, and pre-heating lines; high speed billet heating furnaces; and batch-type forge furnaces.

The Bloom High Thermal Release Burner with its sturdy construction is ideal for applications requiring speed and precision heating.

PATENT PENDING



BLOOM ENGINEERING CO., INC.
837 W. North Avenue Pittsburgh 33, Pa.

Meetings

▲The second Mexican national congress held by the National Chamber of the Iron and Steel Industries will be held at Vera Cruz, Mexico, March 17 through 21.

The program will feature technical papers on raw materials and transportation, import and export problems, industrial relations and production problems, and general technical reports.

The first congress held at Monterrey, Mexico, in October of 1955 featured a number of papers by U. S. Steel men.

▲The American Society for Testing Materials meets for its annual Committee Week and Spring Meeting, February 4–8, at the Benjamin Franklin Hotel, Philadelphia, Pa.

Of the Society's 80 main technical committees, 35 will be in session during the week. Over the five day period, more than 350 committee and subcommittee meetings will take place.

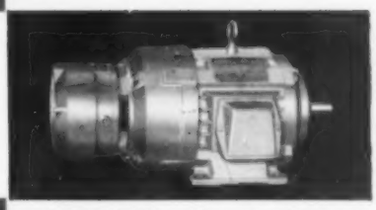
NEW RELIANCE BRAKEMOTOR

These new motors are specifically designed for tough operating conditions. Corrosion-proof cast-iron housings and sealed joints make this motor impregnable to foreign material.

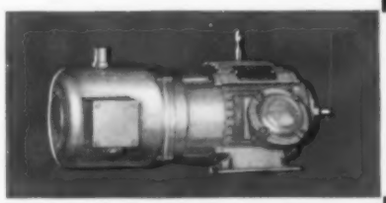
Braking torque ratings from 3 ft. lbs. thru 345 ft. lbs. Fail-safe mechanism immediately applies brake in case of power failure. One piece molded brake linings provide fast, smooth stops and unmatched holding power for heavy loads.

Simple brake has only six parts and requires no control wiring or auxiliary electrical equipment. Compact construction requires a minimum of space. Wearing parts are easily accessible for fast maintenance.

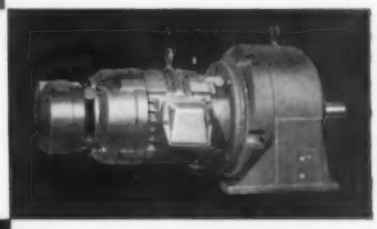
For further information write for bulletin B-2503. B-1533



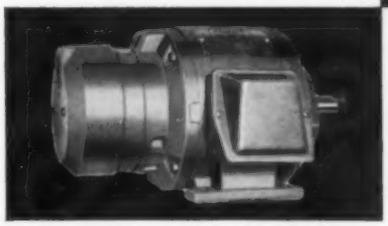
Totally-Enclosed, Corrosion-Proof



Explosion-Proof—Cl. I, Gr. D and Cl. II, Grs. E, F & G



Corrosion-Proof Gearmotor



Protected

See Your RELIANCE Sales Engineer TODAY

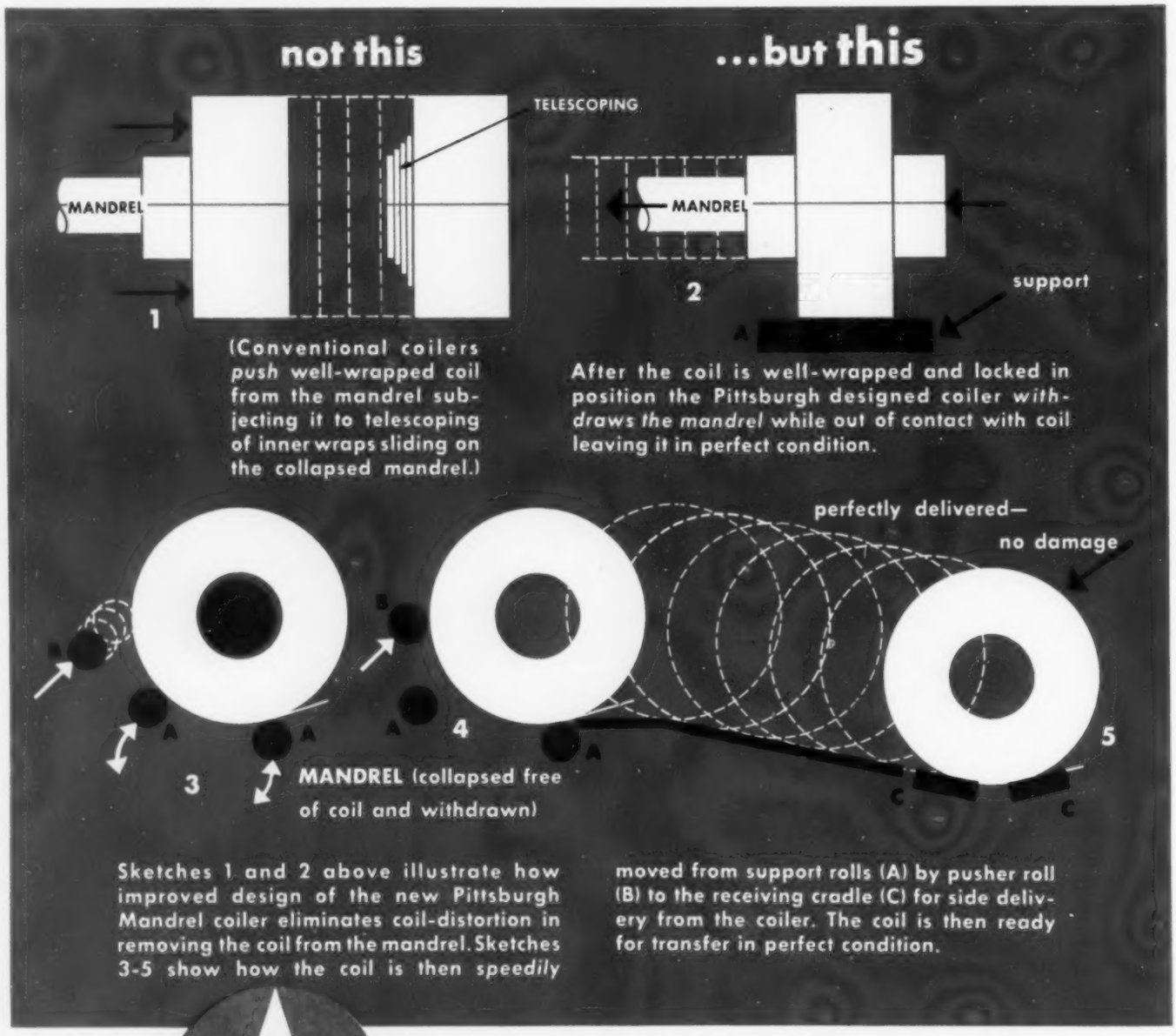
RELIANCE ELECTRIC AND ENGINEERING CO.

Dept. 111A, Cleveland 10, Ohio • Canadian Division: Welland, Ontario
Sales Offices and Distributors in Principal Cities

New hot strip coiler

by Pittsburgh

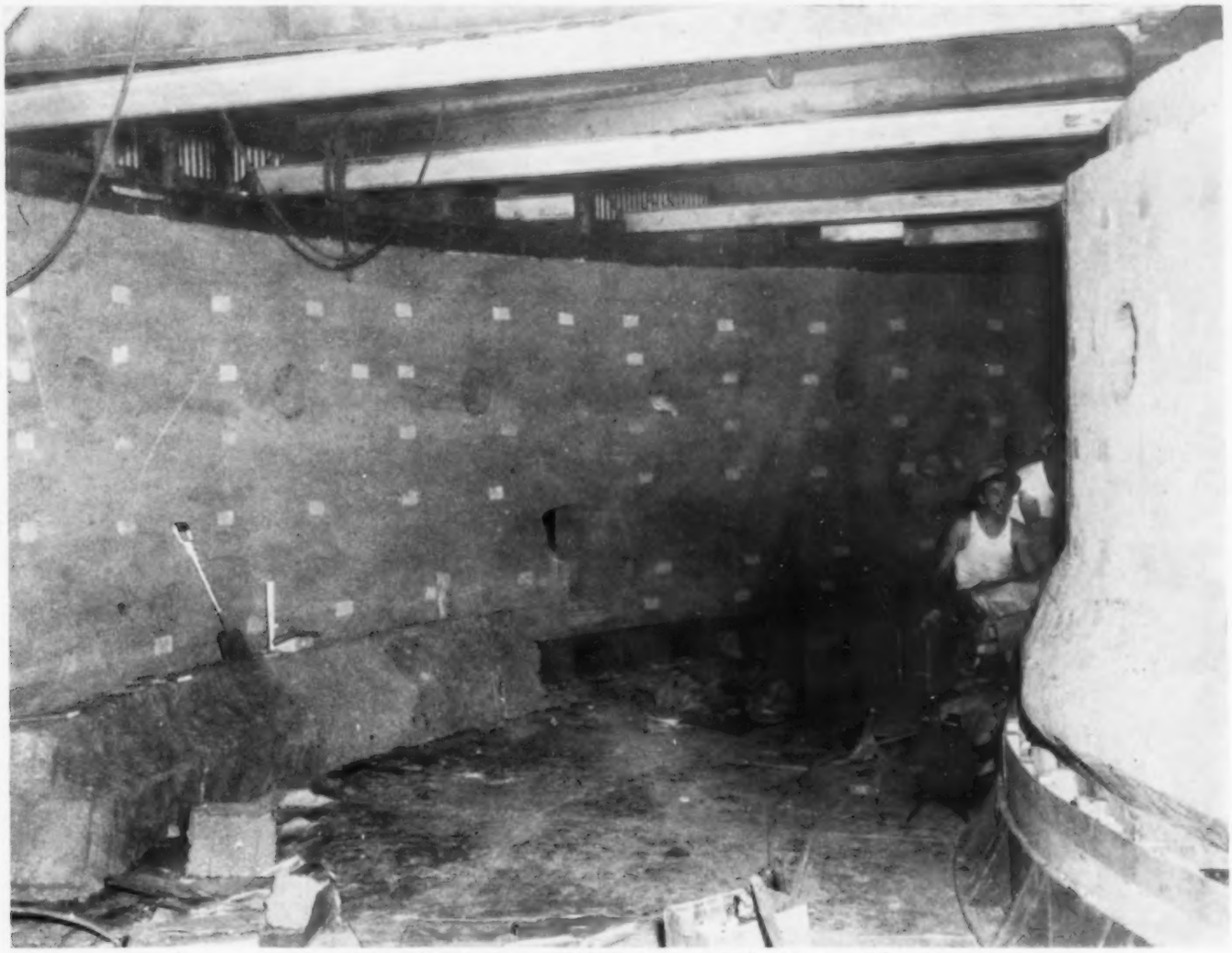
Delivers each coil in perfect condition


not this
...but this
TELESCOPING
MANDREL
1
(Conventional coilers *push* well-wrapped coil from the mandrel subjecting it to telescoping of inner wraps sliding on the collapsed mandrel.)
MANDREL
2
support
A
After the coil is well-wrapped and locked in position the Pittsburgh designed coiler *withdraws the mandrel* while out of contact with coil leaving it in perfect condition.
perfectly delivered—
no damage
B
A
A
A
A
4
5
3
MANDREL (collapsed free of coil and withdrawn)
C
C
Sketches 1 and 2 above illustrate how improved design of the new Pittsburgh Mandrel coiler eliminates coil-distortion in removing the coil from the mandrel. Sketches 3-5 show how the coil is then *speedily* moved from support rolls (A) by pusher roll (B) to the receiving cradle (C) for side delivery from the coiler. The coil is then ready for transfer in perfect condition.

Pittsburgh
ENGINEERING & MACHINE CO.
Division of Pittsburgh Steel Foundry Corporation

Rolling mill equipment by Pittsburgh performs in a superior manner because it is superior in design. Call us for advice on problems you may have with existing equipment and for quotations on new installations.

P. O. BOX 986, PITTSBURGH 30, PENNSYLVANIA
PLANT AT GLASSPORT, PENNSYLVANIA



View of Ramtite lined walls and WASP hearth rim in 55 ft. rotary hearth furnace.

Proven Performance Paves The Way To NEW FURNACE Orders For Ramtite®

Cost reducing performance in existing furnaces of an eastern steel mill led to the installation of Ramtite in the outer and inner walls, hearth and hearth rim of this 55 ft. rotary hearth furnace. The furnace was designed and built by Salem-Brosius, Inc.

Ramtite Safe-Tie Refractory Anchors securely tie the walls back to the steel structure to prevent bulging. Combined with Ramtite's inherent spall resistance, this assures longer wall life.

The hearth rim is lined with WASP, a special grade of air setting Ramtite which develops very high strength at moderate temperatures, eliminating the difficulties often experienced with rim tiles which spall or work loose, move out and jam into the sides of the furnace.

The Ramtite Co. offers you a complete sales engineering service—experienced men who are always available to study your refractory problems and consult with your engineering, mason and ceramic departments about your specific needs.

Write for free bulletin or call your local Ramtite representative for further information.

Can You Afford Not to Use Ramtite?

The Ramtite Co.
DIV. OF THE S. OBERMAYER CO.

THE RAMTITE CO., Div. of The S. Obermayer Co.
1813 South Rockwell St., Chicago 8, Ill.

Please send Items checked

- ☐ Bulletin on Ramtite Plastic Refractory in Steel Plant Furnaces.
- ☐ Bulletin on Castable and Gunning Refractories.

Company Name_____

Attn. Mr._____ Title_____

Address_____

City_____ Zone_____ State_____

© 1957

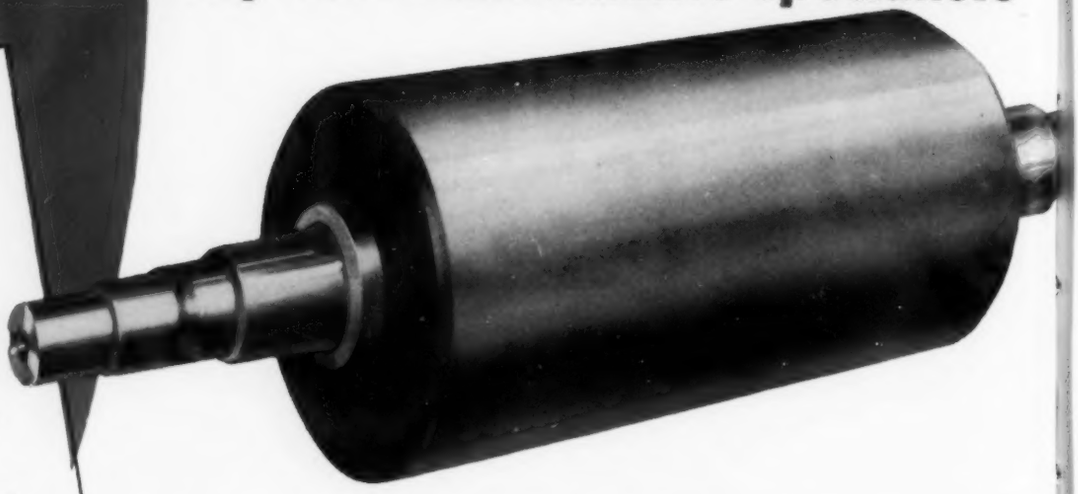
This is another in a series of advertisements depicting ways Ramtite Refractories serve the steel industry.

Get the right answers to your Roll problems from "YOUNGSTOWN"

hot and cold strip mill maintenance specialists

Q. How can scratching, galling, pickup, and excess wear be eliminated?

A. Use PARALLOY... the Rolls of uniform hardness all through. Roll more tonnage from new to scrap diameter.



PARALLOY

HOT STRIP COILER ROLLS • COILER PINCH ROLLS
PICKLING LINE PINCH ROLLS • UPCOILER ROLLS
CLEANING LINE PINCH ROLLS • SINKER ROLLS
CARRIER ROLLS • TEMPER MILL TENSION ROLLS

Q. How can heat check, warpage and cracking be overcome?

A. Let Youngstown's proven experience with Ductile Cast Iron help you in the applications at right.

DUCTILE IRON

RUNOUT TABLE ROLLS • HOLDING TABLE ROLLS
LOOPER TABLE ROLLS
LOOPER TABLES • APRON PLATES

Ductile Cast Iron Rolls are reducing maintenance in hot strip mills . . . especially good under the sprays. We invite your inquiries on rolls or any other ductile iron castings up to 50,000 pounds.

The Youngstown Foundry & Machine Co.
SERVING INDUSTRY SINCE 1885
Youngstown, Ohio

You can pull these plugs at full load . . . SAFELY!

Circuit-Breaking Arktite

PLUGS AND RECEPTACLES

20 amp. to 400 amp.—250V D.C.; 600V A.C.

SAFE at all times—even if you pull an *Arktite* plug to disconnect an energized motor or appliance in an emergency!

You don't have to open the disconnect switch before withdrawing an *Arktite*. Arcs created as line and load poles disengage are confined in deep, insulated arcing chambers—are instantly snuffed out by pressure-deionization and lack of oxygen. There's no possible danger of flashover injuring personnel or destroying property.

Contact your Crouse-Hinds Distributor, nearest Crouse-Hinds Office or Representative for complete information.

NEW, Re-Designed *Arktites*...

Feature new pressure connectors — new easier-to-wire 1-piece interior assemblies — new easier-to-interchange plug and receptacle interiors — new plug adaptability to any type and size cable.

Fully interchangeable with older style. Same price. Currently available in 30 and 60 amp. sizes, in 2-, 3- and 4-poles.

● Operated like a giant switchboard, this *Arktite* installation with variations in power, frequencies and voltages is used to speed up machine tool testing. Plugs can be inserted and withdrawn from "live" receptacles without using a disconnect switch.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

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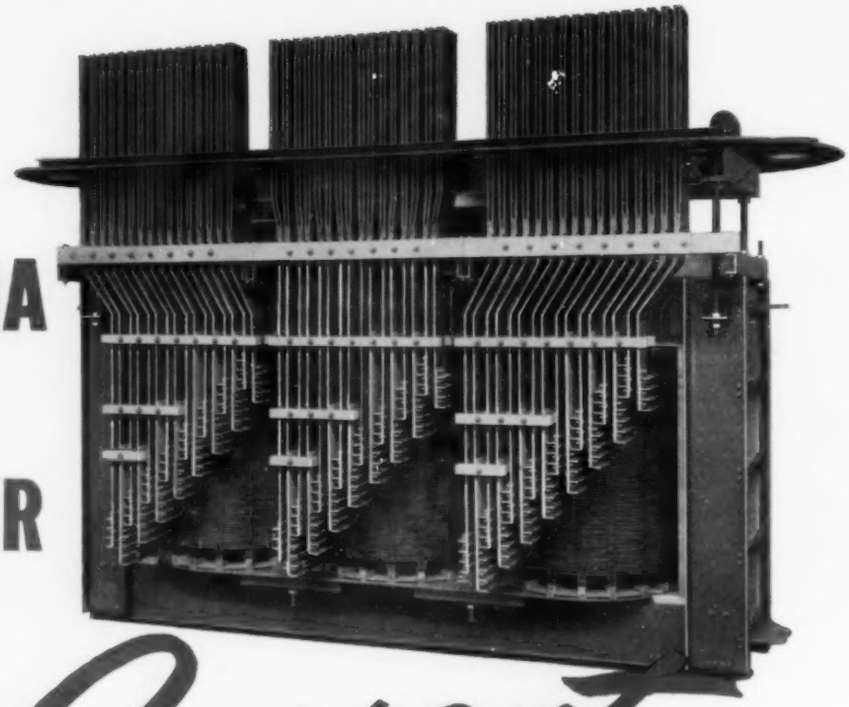
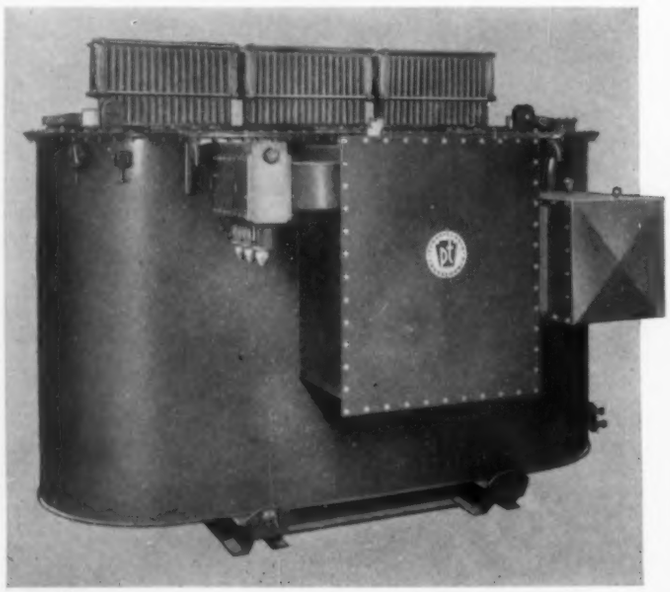
Crouse-Hinds Company of Canada, Ltd. Toronto, Ont.

CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING

Does this PENNSYLVANIA FURNACE TRANSFORMER set a *High Current Record?*



Investigation seems to indicate that it does — but record or not, the 82,000-ampere low voltage line current for which the unit is designed definitely is one of the highest current ratings ever provided for a furnace transformer in this country.



This extremely high current can be delivered at the future transformer rating of 21,300 kva. Now rated at 16,000 kva (with a maximum L.V. line current of 61,600 amperes), the three-phase unit has provisions for the addition of forced-oil cooling equipment to supplement the present water cooling and achieve the higher kva rating.

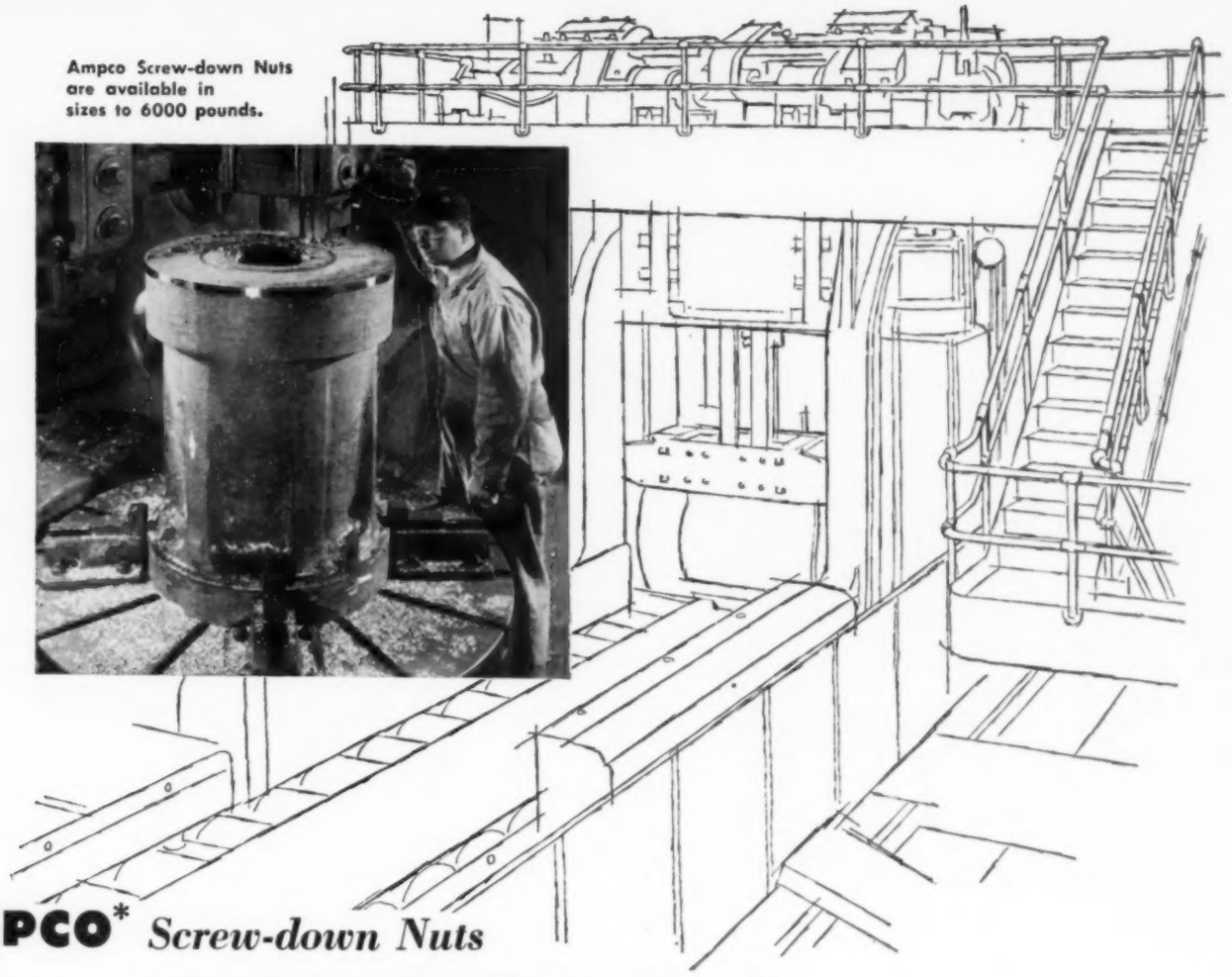
The transformer has a high voltage rating of 13,200 delta volts, and a low voltage rating of 250 delta volts with a full-capacity tap range in 10-volt steps down to 150 volts. The high L.V. line current results from the high kva and the fact that the lowest low voltage tap is at full capacity. The various low voltages are accomplished by means of a motor-operated, remote-controlled tap changer in the H.V. winding.

Pennsylvania now has designed and built furnace transformers ranging from 250 through 25,000 kva, and from 3175 through 82,000 amperes. Why not put this furnace transformer know-how and experience to work for you?

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division **CANONSBURG, PA.** Greater Pittsburgh District

Ampco Screw-down Nuts are available in sizes to 6000 pounds.



AMPCO* *Screw-down Nuts*

help strip mill set production record

— handle extreme pressures to avert costly downtime and replacement

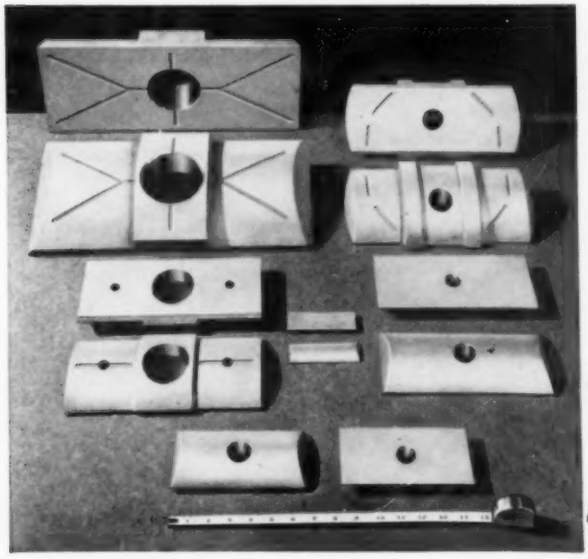
Here's where Ampco Metal's good bearing qualities, high compressive strength and ability to withstand tremendous impact and shock loads really pay off. Ampco Screw-down Nuts eliminate expensive adjustment and downtime . . . don't squash out. For example, one stand of an 80" hot strip mill using Ampco Nuts, utilizes 4500 hp at speeds up to 282 rpm. That means "king-size" stresses and strains. Yet the records show that in spite of normal screw-down pressures of between two and three million pounds, this mill produced over three million net tons of steel in 1953. Virtually no time was lost for screw-down nut replacement or adjustment.

Ampco Screw-down Nuts are centrifugally cast to insure sound structure and good wear resistance. They're available in sizes to 6000 pounds.

And Ampco slippers help keep mills running longer, too, because they have remarkable stamina . . . real resistance to wear and punishing shock loads. Mills that set production records depend on Ampco slippers to end frequent replacement — reduce spindle wear.

Slippers are available as rough castings or "cast-to-size" — minus 0, plus 1/32" or plus 0, minus 1/32". Oil grooves are cast in — if you want them.

Find out how these and other Ampco products provide real dollars and cents savings in *your* mill. Contact your nearest Ampco field engineer or write us direct.



Ampco Slippers available either as rough castings or "cast-to-size." Oil grooves can be cast in.

AMPCO®

Sole producer of genuine Ampco Metal

*Reg. U. S. Pat. Off.

G-37

Ampco Metal, Inc.

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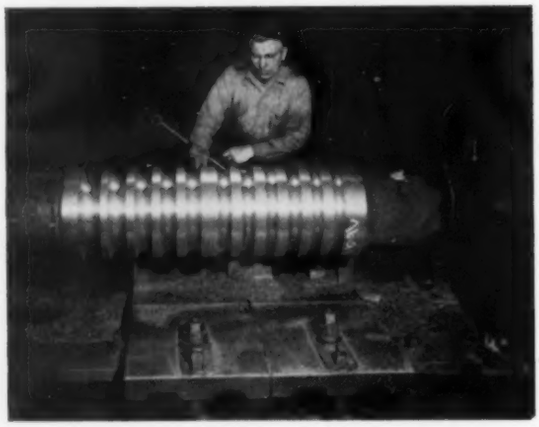
West Coast Plant • Burbank, California

TIPS FROM A ROLL MAKER'S NOTEBOOK

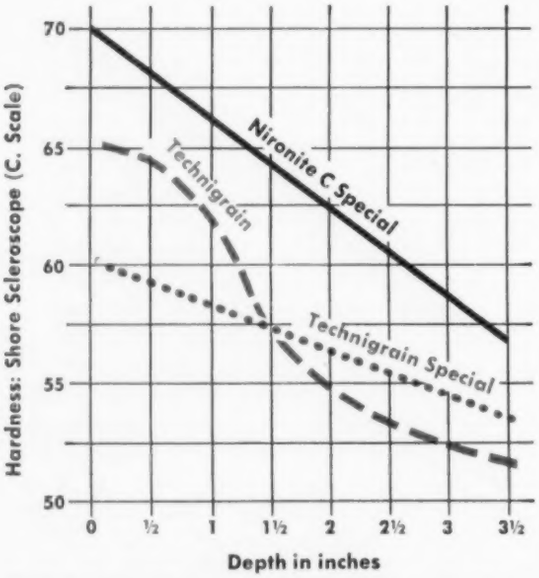
MACKINTOSH-HEMPHILL DIVISION, E. W. BLISS COMPANY, Pittsburgh 3, Pennsylvania

Cast mill rolls • Johnston cinder pots • rotary tube straighteners • end-thrust bearings • heavy-duty lathes • steel and special alloy castings

A merchant mill roll should be just good enough



Easy to turn: Mack-Hemp *Technigrain* and *Technigrain Special* rolls are readily turned and redressed.



Technigrain rolls compare favorably in hardness penetration with more expensive, higher-alloy types, as shown by these generalized curves.

The wise purchaser of merchant mill rolls buys rolls that give him the service life he needs *and no more.*

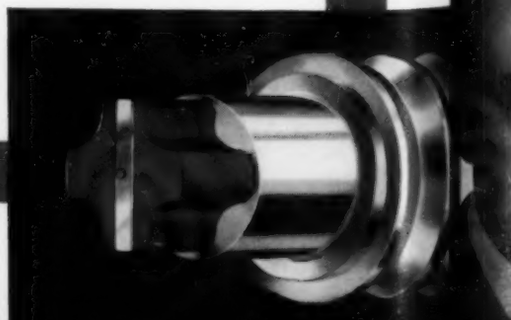
This is because increased roll service life usually goes hand in hand with higher alloy content and more complex heat treatment. Both add to the price of the rolls. But... most merchant mill operators redress their rolls after each production run. Thus, if a set of rolls is still good for more tonnage before redressing at the end of a run, chances are that the rolls are too good—and therefore too expensive—for the job.

But price is not the only consideration. To be just "right", a merchant mill roll should (1) offer wearing qualities closely related to the length of the production runs for which it is used; (2) have good hardness penetration to provide wear resistance at the bottom of passes; and (3) have grain structure fine enough to assure good finish of the rolled product.

Quality at low price. Mack-Hemp *Technigrain* and *Technigrain* Special rolls offer an inexpensive solution. In fact, *Technigrain* rolls are so generally useful for all merchant shapes that they have virtually eliminated the roll inventory problem for many operators. At a price that averages several cents per pound less than higher-alloy grain rolls, *Technigrain* and *Technigrain Special* provide service life adequate for the vast majority of applications. Available in a hardness range of 55 to 60 Shore (C Scale), they offer good hardness penetration and finely dispersed graphite to provide a smooth work surface. Of course, for unusually severe merchant mill service, Mack-Hemp's *Nironite C Special* offers all of Technigrain's properties, in a higher hardness range.

To sum up, *Technigrain* is the ideal roll for general merchant mill use: it is low in cost, it provides sufficient service between redressings, and it rolls products of better-than-adequate surface finish.

Technigrain is only one of the more than thirty types and hundreds of iron and steel roll analyses produced by Mack-Hemp. For advice and information relating to your specific roll application, why not 'phone or write us today? There's no obligation. Address Mackintosh-Hemphill Division, E. W. Bliss Co., Pittsburgh 3, Pa.



MACKINTOSH-HEMPHILL

You get more tonnage from the rolls with the Striped Red Wabblers

Division of E. W. BLISS COMPANY

Presses, Rolling Mills, Special Machinery

Personnel News...

Richard F. Sentner has been named executive vice president—commercial, United States Steel Corp., succeeding **David F. Austin,** who retired December 31, after nearly 39 years of service. Mr. Austin began his career with U. S. Steel in 1918 in the New York office of the corporation. After serving in minor capacities, he held several sales assignments, served as manager in three district sales offices, and in 1938 was elected vice president in charge of sales of the Carnegie-Illinois Steel Corp. During World War II, Mr. Austin joined the War Production Board and served successively as executive consultant, assistant director, deputy director, and acting director of the Iron and Steel Division. Returning to the vice presidency of Carnegie-Illinois in July, 1943, he was elected vice president of the U. S. Steel Corp. of Del. in 1945. In January, 1951, he became executive vice president—commercial of U. S. Steel Co. and since January, 1953, has held the same position with U. S. Steel Corp. Mr. Sentner began his business career in New York City in 1926 as a salesman for the Wheeling Steel Corp. He served in various capacities with that company from 1926 until the end of 1947, becoming successively assistant manager of tin plate sales, manager of tin plate sales, and assistant general manager of sales. From March of 1942 until September of 1945, he served on the War Production Board in Washington and was appointed deputy director of the Board's Iron and Steel Division. He also served as director of the Iron and Steel Division of the National Production Authority, Washington, D. C., from March to September, 1951. Mr. Sentner joined the U. S. Steel Corp. of Del. in January, 1948, as assistant vice president—sales. With the formation of the United States Steel Co. in 1951, Mr. Sentner became assistant executive vice president—commercial, and in January, 1953, when the United States Steel Corp. became an operating concern, he retained that position.

Harry L. Jenter, formerly Cleveland District manager of operations for American Steel & Wire Division, has been named vice president—operations of this division of United States Steel Corp. He succeeds Van H. Leichliter whose appointment as Wire Division president was announced recently. Mr. Jenter joined the Wire Division's Trenton, N. J., Works as a draftsman in 1917, and for the next few years alternately worked for the company and attended college. In 1926 he transferred to the Cleveland office as a student apprentice and in 1928 was made an assistant foreman at the Cleveland Newburgh Wire Works. In 1932 he was transferred to the Cleveland Cuyahoga Works Cold Roll Strip Dept. and in 1934 was made a general foreman. He became assistant superintendent of the Works in 1935 and general superintendent in 1939. In 1942 he transferred to the headquarters office as assistant to the vice president of operations. He resumed his post as general superintendent of Cuyahoga Works a year later. In 1950 he became chief engineer, in 1952, assistant manager of operations Cleveland District, and since 1953 has served in the capacity of manager of operations Cleveland District.

Walter L. Longnecker succeeds Mr. Jenter as Cleveland District manager of operations of American Steel & Wire. Mr. Longnecker moves from his former post as general superintendent of the Wire Division's Cuyahoga Works. **James J. Dalton** has been appointed general superintendent of Cuyahoga Works, succeeding Mr. Longnecker. Mr. Longnecker started as a technical apprentice at the Donora Steel & Wire Works in 1939. He was a general foreman in the rod mills at the plant at the time of his transfer to the Cleveland headquarters office in June, 1945, as division metallurgist, rod mills. Appointed division superintendent of hot mills at Cuyahoga Works in March, 1946, he became general superintendent of that plant December 1, 1951. Mr. Dalton began his steel career in 1944 as senior procedure analyst in the Wire Division's headquarters. In June, 1945—he was advanced to assistant division supervisor of production control in the Cold Roll Dept. at Cuyahoga Works, and three years later he was made division supervisor of production planning. In January, 1953, he was advanced to the assistant division superintendent of the same department, and six months later he was appointed division superintendent of cold roll, a post he has held until his present promotion.

C. J. Duby, chief engineer for Republic Steel Corp.'s Warren District since 1930, has been made chief engineer for the International Projects Division, and **M. H. Warlow,** formerly assistant industrial engineer in Warren, has been made assistant chief engineer, under

RICHARD F. SENTNER

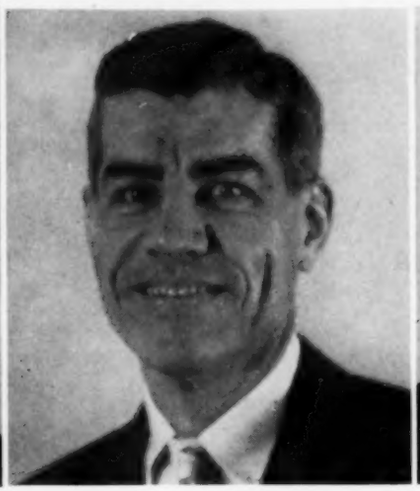
HARRY L. JENTER

WALTER L. LONGNECKER

JAMES J. DALTON

C. J. DUBY

M. H. WARLOW



I. H. LUNDGREN

F. F. KEMP

direction of **D. H. Bellamore,** managing director of the International Projects Division. For the present time, both of the men will continue to headquarter in Warren. The International Projects Division was formed by Republic in November 1955 to handle increasing demands from foreign industries for technical, engineering and licensing of manufacturing procedures developed by Republic. Replacing Mr. Duby as district chief engineer is **I. H. Lundgren,** former assistant chief engineer, and succeeding Mr. Warlow as assistant industrial engineer is **F. F. Kemp,** formerly a time study engineer.

Robert S. Lynch was elected chairman and chief executive officer, and **Howard B. Johnson** was elected president of Atlantic Steel Co. **Charles F. Stone,** board chairman since 1947, was named chairman of the executive committee. Mr. Lynch has been connected in various capacities with the American Sheet and Tinplate, Co., United Alloy Corp., and Republic Steel Corp. He joined Atlantic Steel in 1944 as general superintendent. In 1946 he was made vice president, and in January, 1947, was elected president.

Charles E. Knox was named manager of the newly created Process Engineering and Production Control Department of Crucible Steel Co. of America's Spring Division. Mr. Knox began his career with Crucible in 1950 as an industrial engineer at the company's Park Works. In 1955 he was appointed senior industrial engineer of the Spring Division, and served in that capacity until his present appointment.

Albert B. Millman, formerly assistant superintendent, has been promoted to superintendent, general maintenance department at J&L's Aliquippa Works. **John A. Hussey,** formerly superintendent, has retired and has been retained as consultant-general maintenance. **Francis T. Zitzman** succeeds Mr. Millman as assistant superintendent. **O. C. Gochenour,** formerly general maintenance foreman, tinplate, will succeed Mr. Zitzman as general foreman-maintenance.

Merle J. Graham has been elected vice president, production, Allegheny Ludlum Steel Corp. In addition, **Dr. Rush A. Lincoln** was elected vice president and technical director, and **Carl B. Pollock** was elected vice president, manufacturing planning and policy.

William J. Reilly was appointed general manager of Ford Motor Co.'s Steel Division. Mr. Reilly joined Ford in 1946 and first held the position of assistant superintendent of steel operations. In 1949, he was named manager of steel mills and, from 1953 until appointed to his present post, he was general manufacturing manager of the Steel Division. He joined the metallurgical department of the Youngstown Sheet and Tube Co. in 1926 and remained with the firm until 1946, holding several positions including open hearth superintendent.

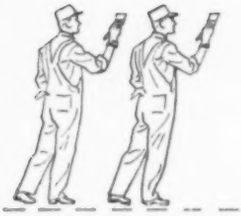
WILLIAM J. REILLY

John M. Walsh, Jr., was named assistant general superintendent, Gary Steel Works, U. S. Steel Corp., Gary, Ind. At the same time, **E. Courtney Sorrells** was named assistant to general superintendent.

Alfred Luconi has been named division superintendent, stainless steel, Gary Sheet and Tin Mill, U. S. Steel Corp., Gary, Ind.

Dr. R. B. Corbett has been appointed director of metallurgy and **J. M. Ford** superintendent of the consumable electrode vacuum melting department of the

Rust-Oleum is distinctive as your own fingerprint. Accept no substitute.



. . . goes on faster, stops rust, lasts longer over rust!

ONE MAN often does the work of two!

EASIER TO USE—because Rust-Oleum 769 Damp-Proof Red Primer goes over rusted metal after scraping and wirebrushing to remove rust scale and loose rust—usually eliminating costly surface preparations. *Stops Rust*—because Rust-Oleum's specially-processed fish oil vehicle *penetrates* rust to bare metal—driving out air and moisture that cause rust.

LASTS LONGER applied over rust—and teamed up with Rust-Oleum's many attractive finish coatings, assures lasting beauty. Try Rust-Oleum on *your* tanks, metal sash, machinery, wire fences, stacks, girders—or around *your* home. Prompt delivery from Industrial Distributor stocks. Write for illustrated literature with color charts showing colors and applications.

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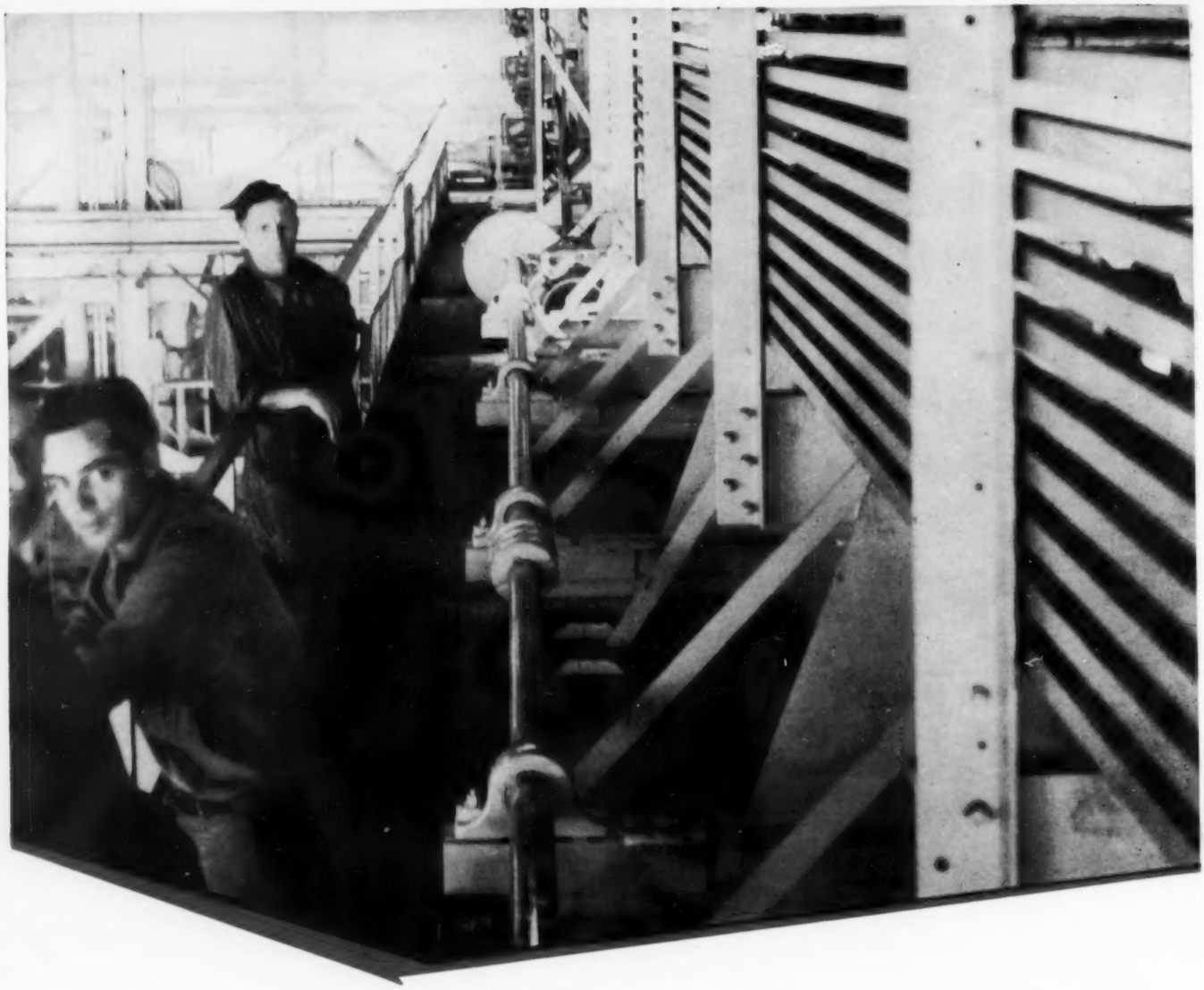
30% GREATER COVERAGE—MANY ATTRACTIVE COLORS

Rust-Oleum covers up to 30% more area, depending upon surface condition and porosity. And you can beautify as you protect with Rust-Oleum finish coatings in Aluminum, White, Red, Gray, Green, Blue, Yellow, Black, etc.

STOPS RUST!®

Rust-Oleum and Stops Rust are brand names and registered trademarks of the Rust-Oleum Corporation.

Write for special report showing Rust-Oleum penetration to bare metal.



here's how Bearings, Inc. cuts the overhead on overhead cranes

This 30 ton crane with a 95 foot span was so inefficient it lost many hours of work every month. The Bearings, Inc. engineer recommended a complete conversion to anti-friction bearings and showed plant management how easily and inexpensively the conversion could be accomplished.

We supplied all bearings, seals, housings, and caps for 16 bridge wheel bearing journal boxes. The drive motor was converted to roller bearing end bells.

Main drive line shaft from the motor to the wheels was converted to roller bearing pillow blocks. An adapter on the wheel axle eliminated machining. The only additional work needed was to weld a plate with bolt hole under the crane frame where units were mounted.

Crane now starts under load at first contact point on control and is the fastest crane in the plant. Crane was pulling 350 to 400 amps.; now uses less than 200 amps. Crane operator withdrew a request for transfer to another crane after conversion was completed.

Do you have a slow moving, inefficient crane in *your* plant? Ask our branch nearest you to show you how it can be converted to a fast, efficient piece of equipment at a minimum expense. Call or write NOW.

Rendering bearing service in the territories adjacent to our branches, listed below.

BEARINGS, INC.

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute
PENNSYLVANIA: Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Wheeling
NEW JERSEY: Camden • **MARYLAND:** Baltimore
Subsidiaries: Balanrol Corp. • Buffalo, N.Y.•
Kentucky Ball and Roller Bearing Co. • Louisville, Ky.

Midvale—Heppenstall Co. Both men were transferred from the Pittsburgh plant of Heppenstall. Dr. Corbett joined Heppenstall in 1945 as a research metallurgist. He was named research engineer in 1950, director of research in 1952, and was promoted to assistant to the president (technical) in March, 1956. Mr. Ford started with Heppenstall in 1946 as a laboratory technician and has served as combustion engineer since February, 1956.

Charles P. Showalter was appointed superintendent, Blooming Mills Department, Duquesne Works, United States Steel Corp. Mr. Showalter joined U. S. Steel at Duquesne Works in 1941 as industrial engineer. Prior to his present appointment Mr. Showalter was assistant superintendent, blooming mills.

Clyde A. Rodgers has been appointed assistant superintendent of oxygen steelmaking production at Kaiser Steel Corp. Mr. Rodgers came to Kaiser Steel in 1946 from Youngstown Sheet and Tube Co. where he was metallurgical observer and practice engineer in the open hearth division for 11 years. At Kaiser he became assistant to the superintendent of the open hearths, chief observer, then product metallurgist and chief inspector for the primary rolling mills.

James H. Bray has been appointed manager of the roll department at Birdsboro Steel Foundry and Machine Co. He was assigned to his new position after serving nine years in the Pittsburgh area as roll sales representative for the company. As roll department manager, Mr. Bray will be responsible primarily for sales and service in the Eastern, Buffalo and Canadian steel districts. He was formerly supervisor of alloy steel rolling and inspection at A. M. Byers Co., and before that, superintendent of blooming mill operations at Copperweld Steel Co.

Stuart H. Smith has been elected to the office of vice president in charge of sales for SKF Industries, Inc. Previously he was general sales manager. Mr. Smith began his career with SKF as a sales representative in the Cincinnati district office in 1934. He was subsequently made assistant district manager of the Detroit district, remaining there five years at which time he returned to Cincinnati as district sales manager. In 1950 Mr. Smith moved to the company's headquarters offices in Philadelphia to assume the position of manager of industrial development. In January of the following year, he was appointed assistant sales manager. He was made sales manager in 1952 and, two years later, he was promoted to the position of general sales manager.

Kempton Dunn, president of American Brake Shoe Co., has been elected chief executive of the company. **Wm. B. Given, Jr.,** who has been chief executive officer of the company, will continue actively as chairman of the board. Mr. Dunn was elected president of Brake Shoe in January, 1954. He has been with the company since 1932. He became treasurer in 1942 and was also secretary from 1947 to 1949 when he was elected a vice president. He became first vice president of Brake Shoe and a director of the company in 1952.

John R. Duffy has been named chief engineer, Lindberg Engineering Co. In addition to directing activities of an expanded engineering department he will be responsible for the design of the company's complete line of heat treating furnaces, kilns and high vacuum heating equipment.

Theodore L. Kishbaugh, formerly manager of the Los Angeles steel service plant of Joseph T. Ryerson & Son, Inc., was appointed assistant vice president in the company's procurement department. At the same time **Wayne D. Dukette,** manager of the Ryerson plant in San Francisco, was named general manager of the Los Angeles plant. Mr. Kishbaugh became manager of the Los Angeles plant in 1948, after two years as assistant manager. He was formerly with the Bethlehem Steel Co., and just prior to joining Ryerson was vice president and merchandising manager of Earle M. Jorgensen Co. Mr. Dukette has been plant manager at San Francisco since 1947. Previously he managed the Ryerson plant in Cincinnati, and also served as manager of railroad sales and assistant sales manager at Chicago. He joined the company in 1923.

Frank M. Norton was appointed vice president and **H. E. Imes,** director of operations of Semet-Solvay Division, Allied Chemical & Dye Corp. Mr. Norton

HARLES P. SHOWALTER CLYDE A. RODGERS JAMES H. BRAY STUART H. SMITH

has held various positions at the company's Detroit, Mich., and Ashland, Ky., coke plants including that of assistant superintendent at both plants. He was transferred to New York in 1951 as project engineer. In 1952 he became production manager, Petrochemical Department and three years later was appointed assistant to vice president. Mr. Imes started with Semet-Solvay at its Ironton, Ohio, coke plant in 1922. He rose to the position of superintendent of Semet's Ashland coke plant in 1933 returning to the Ironton plant as superintendent in 1940. He was appointed district superintendent for Ashland and Ironton coke plants and River Transportation Department in 1943 and became assistant general superintendent for all four coke plants and River Transportation Department in 1951. He was transferred to New York two years later. Mr. Imes' post as director of operations is a newly created one required by the expansion of Semet-Solvay's activities in the fields of coke and polyethylene products.

Philip G. Monteith has been appointed assistant to the sales manager for the Laclede-Christy Co. Division, H. K. Porter Co., Inc. He was previously employed by Chicago Vitreous Corp.

Clinton E. Smith, who has been associated with the Pratt & Whitney Co. for the past 25 years, has been named assistant to the general sales manager. Mr. Smith came to the company in 1931 when it purchased

CLINTON E. SMITH

the Keller Mechanical Engineering Co. He took part in integrating the manufacturing operations of Keller with those of Pratt & Whitney. Since 1936 he has been active in the sales activities of the company's line of cutting tools.

E. F. Koenig has been appointed technical representative of the Technical Services Division of The Texas Co.'s Research and Technical Department. In his new position, Mr. Koenig will specialize in the field of additives for petroleum lubricants. His headquarters will be at Beacon, N. Y., where the Texaco Research Center is located. Until his recent promotion, he was a technical services associate.

Robert P. Gibson has been named as assistant superintendent of the blooming and billet mills at Republic Steel Corp.'s Buffalo plant. Previously he had been assistant to the superintendent of the masonry department.

Robert E. Buckholdt was named manager of engineering of Selas Corp. of America. For the past 23 years Mr. Buckholdt has been active in the furnace industry: in design, engineering and sales positions with Electric

ROBERT E. BUCKHOLDT

Furnace Co., Salem Engineering Co. and Salem Brosius, Inc. He comes to Selas from Kendall Contracting Inc., Alliance, Ohio, where, in the position of vice president, he engaged in engineering, layout and construction of forging plants.

Howard H. Shakely has been appointed to the new position of plants engineer of Jones & Laughlin Steel Corp. He formerly was consultant to the chief engineer. **P. H. Reynolds, Jr.,** has been named contract engineer. Mr. Reynolds formerly was staff engineer—rolling mills. Also, **John G. Blissell** has been appointed specification and control engineer. He formerly was chief design draftsman in the Design Engineering Department of J&L's Aliquippa Works. Mr. Shakely started in 1918 in the Pittsburgh Works' Steam Efficiency Department, and, following a series of promotions, was named assistant works manager at Pittsburgh Works in 1951. He was promoted to works manager at the Cleveland Works in 1952, and was appointed to the position of consultant to the chief engineer in 1955.

Jack H. Hopper was named manager of application engineering for the East Central District of General Electric Co.'s Apparatus Sales Division. He joined the GE test program in 1930, and became head of test and assistant general foreman between 1930 and 1936. From 1936 to 1941 he was a design engineer in the Industrial Control Department. From 1941 until his recent appointment he was with the Steel Mill unit of the Systems Application Engineering Section, part of that time as senior engineer.

C. W. DeZutter has been named superintendent of the open hearth strip and bar mills; **L. A. Schettler** has been made superintendent of the Bessemer rolling and finishing mills; and **G. W. Ransom** has been appointed superintendent of roll shops all at Republic Steel Corp.'s Youngstown plant. Mr. DeZutter has been with Republic for 32 years. He started as an assistant roller in

Often seen in Engineers notebooks

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They always meet our specs.

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We'll use Illinois Gear as our source. I like their quality and service too!
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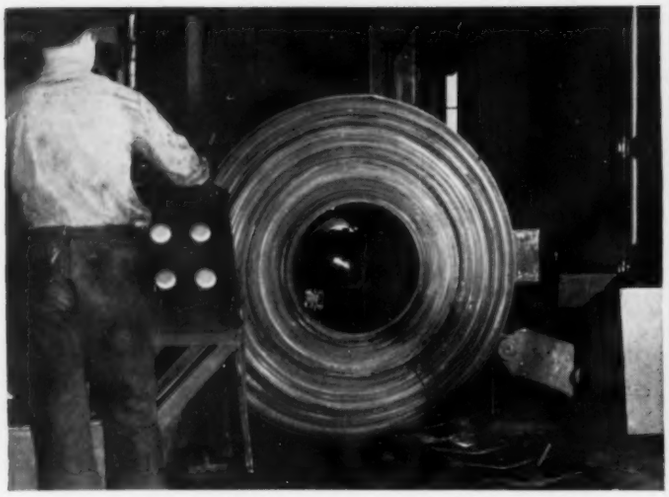
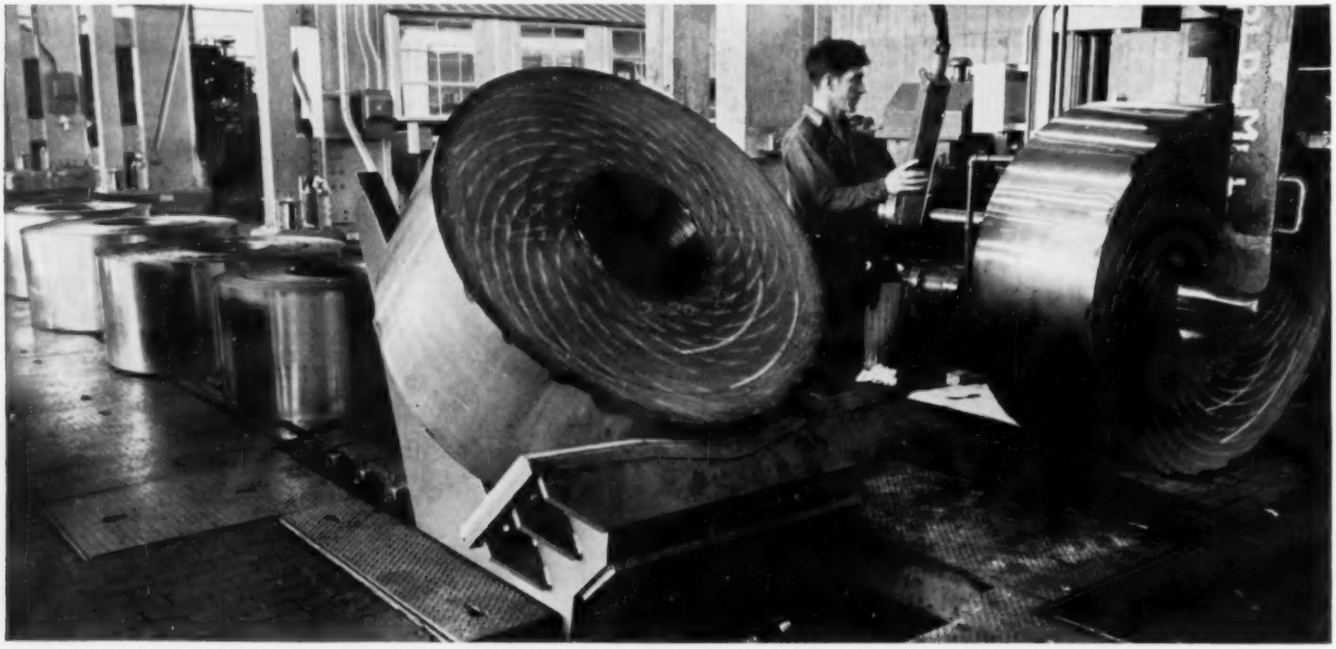


1 Link-Belt hydraulic lift raises coil at end of ride on cold mill entry conveyor. Then conveyor is reversed to separate this coil from others. Lowered into position, coil is discharged down a ramp by a hydraulic push-off arm, also supplied by Link-Belt.

2 From cold mill, coils roll down a ramp where they are stopped by a spring-loaded bumper. They come to rest on this Link-Belt downender which tilts and places them on the 40 ft. delivery conveyor. At end of trip, coils are removed by overhead crane.



3 Coils travel a 40 ft. conveyor to temper mill. Here a Link-Belt upender places coil on its side for pickup by overhead crane. Conveyor is reversible to give clearance for action of upender. Operator has "push-button" control of equipment.

Let Link-Belt coil conveyors lead you to

new yield and safety records

STUDY any mill that's setting production records. You're sure to find absence of waste . . . minimum physical labor and injuries . . . full utilization of capacity. To achieve all three, Alan Wood Steel Co. has Link-Belt coil conveyors installed at their Conshohocken, Pa. plant.

Their system consists of a pallet-top and two double-strand, flat-top roller chain conveyors, all durably designed to provide a steady flow of cold rolled strip. Reversible cold mill and temper mill entry conveyors allow coils to travel close together, assuring ample live storage capacity.

In steel mills all over the country, Link-Belt conveyors handle everything from raw materials to finished products with similar efficiency and economy. It will pay you to call in Link-Belt whether you're modernizing or building a new mill. Link-Belt specialists—working with your own engineers, consultants and builders of mill and process equipment—can help you select the right conveying system for your exact needs.

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MATERIALS HANDLING, PROCESSING & POWER TRANSMISSION EQUIPMENT

14.003

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Republic's Buffalo District. He later was promoted to roller, then assistant superintendent of bar mills in the Buffalo district before moving to Youngstown in 1948 as superintendent of the Bessemer finishing mills. Mr. Schettler has been associated with Republic in the Youngstown steel plant since 1925. He held numerous positions in the district's roll shops before becoming superintendent in 1950. Mr. Ransom has been with the company since 1925. He served as a draftsman in Canton with a predecessor company before Republic was organized in 1930. He moved to Youngstown as foreman in the open hearth roll shop in 1949 and was made general foreman of the district roll shops in 1950.

Earl Hottel has been named head of the newly established service and parts department of Lectromelt Furnace Co. Formerly with the Pennsylvania Transformer Co., Mr. Hottel will direct the handling of all customer services such as the scheduling of Service Engineers who work in the field to set up furnaces and get them into operation as well as for regular inspections and repairs. His department will also handle repairs to and adjustments on existing units.

George D. Williams has been appointed manager of Bailey Meter Co.'s Boston district office. He succeeds **P. T. Reuter** who died October 5. Mr. Williams has been with Bailey Meter since 1946.

Edward M. Hanson has been named manager of the new Baltimore, Md., sales office of the Clark Controller Co. He joined Clark in 1953, and after a period of service in the company's home office served as an application engineer in Clark's Philadelphia office prior to his new assignment. The office will serve Md. and the District of Columbia.

Byron K. Elder has been named chief metallurgical engineer-service of Pittsburgh Steel Co.'s Metallurgical Department. In addition **Russell M. Kotys** has been appointed a metallurgist for the Sheet Division at Allenport.

R. D. Baker, Jr., has been promoted to the position of assistant sales manager of the Coke and Iron Division of Pittsburgh Coke and Chemical Co.

Obituaries

Charles F. Ramseyer, chairman of the board of Ramseyer & Miller, Inc., New York, died December 9. Mr. Ramseyer attended Boston public schools and Roxbury Latin School, graduated from Harvard University and did graduate work at Massachusetts Institute of Technology. He joined Illinois Steel Company and after six years in blast furnace and metallurgical work, went with an electric utility company, where he headed research and development work. In 1943, Mr. Ramseyer became metallurgical engineer and later assistant to the president of H. A. Brassert & Company. In 1950, with J. R. Miller, he founded Ramseyer & Miller, Inc., serving as president until 1955, when he was made chairman of the board. Mr. Ramseyer was active in engineering society work and presented many fine technical papers.

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Corrugating and Complete Line of Culvert Equipment—Slitting and Coiling Equipment for Ferrous and Non-Ferrous Material in All Capacities—Warehouse and Steel Mill Cut to Length Lines for Shearing and Levelling Sheets from Coils—Shears for Shearing Sheets and Plates Both Underdriven and Overdriven Types in all Capacities up to 1¼" plate.

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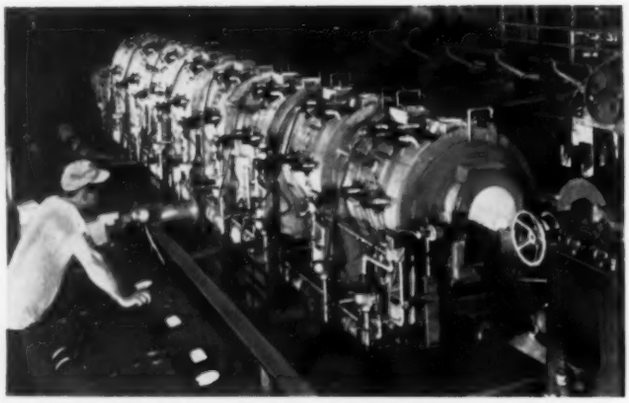
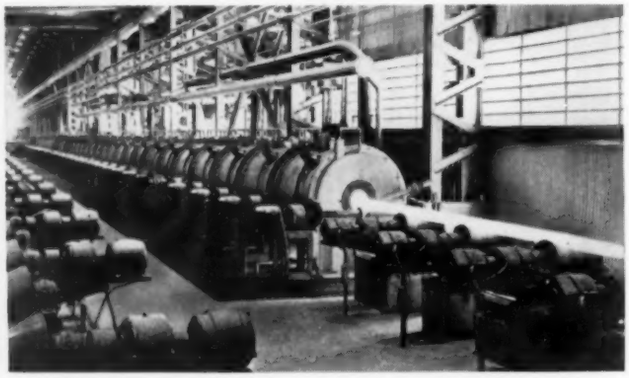
Selas Barrel-Furnace Lines Heat Treat Tubes and Bars . . . in Continuous Operations at Mill Speeds

Continuous hardening and tempering seamless tubes at Colorado Fuel and Iron.



Heating for sizing the heaviest wall seamless tubing produced in the U. S., at Phoenix Iron and Steel.



Normalizing welded tubing in 66 sec . . . compared with conventional practice of 21 min . . . helps Lone Star Steel turn out an improved product, faster.

steel companies use Selas Gradiation® Heating in specially designed barrel-furnace lines to do a wide variety of heat processing . . . to keep pace with high production demands

Selas barrel-furnace lines throughout the steel industry perform their heating jobs as part of in-line continuous production operations, automatically controlled. The compact, space-saving, gas-fired furnaces deliver uniform heating with speed and precision.

Send for informative articles on Selas tube and bar heating installations. Address Dept. 41.

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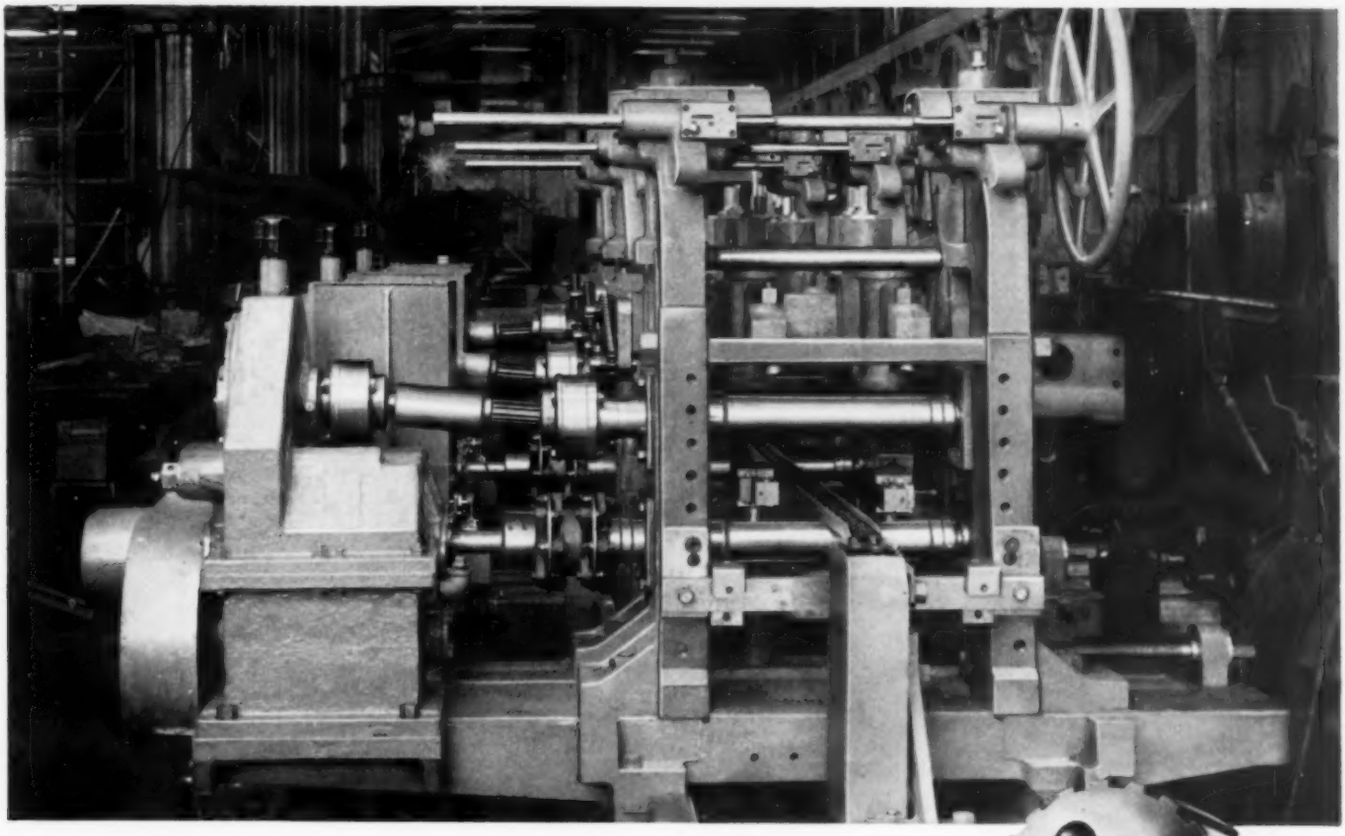
Heat and Fluid Processing Engineers

DEVELOPMENT • DESIGN • CONSTRUCTION

How RZEPPA constant velocity universal joints help provide scratch-free aluminum extrusions



PROBLEM:

This equipment—built by the Sutton Engineering Company, Pittsburgh—is the answer to a problem common to processors of extrusions: how to correct cross-sectional distortions that occur in the extrusion and heat treatment of today's complex shapes.

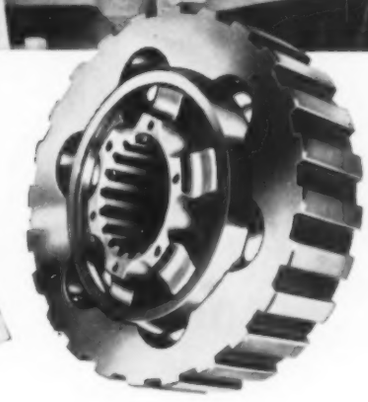
SOLUTION:

Sutton solved this problem with their new concept of giving accurately-proportioned torque to the top and bottom rolls through differential gearing.

Rzeppa Constant Velocity Universal Joints were added to overcome scratching and gouging caused by the irregular action of ordinary universal joints. Rzeppa Joints are giving scratch-free finishes even at extreme operating positions.

Other *modern design* advantages offered by Rzeppa include:

- INCREASED SPEEDS
- REDUCED DOWN-TIME
- LOWER MAINTENANCE
- HIGHER CAPACITIES



If you would like to know more about the outstanding capabilities of Rzeppa Constant Velocity Universal Joints, write today for your free copy of this complete, informative brochure.

RZEPPA SHEPPA

CONSTANT VELOCITY UNIVERSAL JOINTS

THE GEAR GRINDING MACHINE COMPANY

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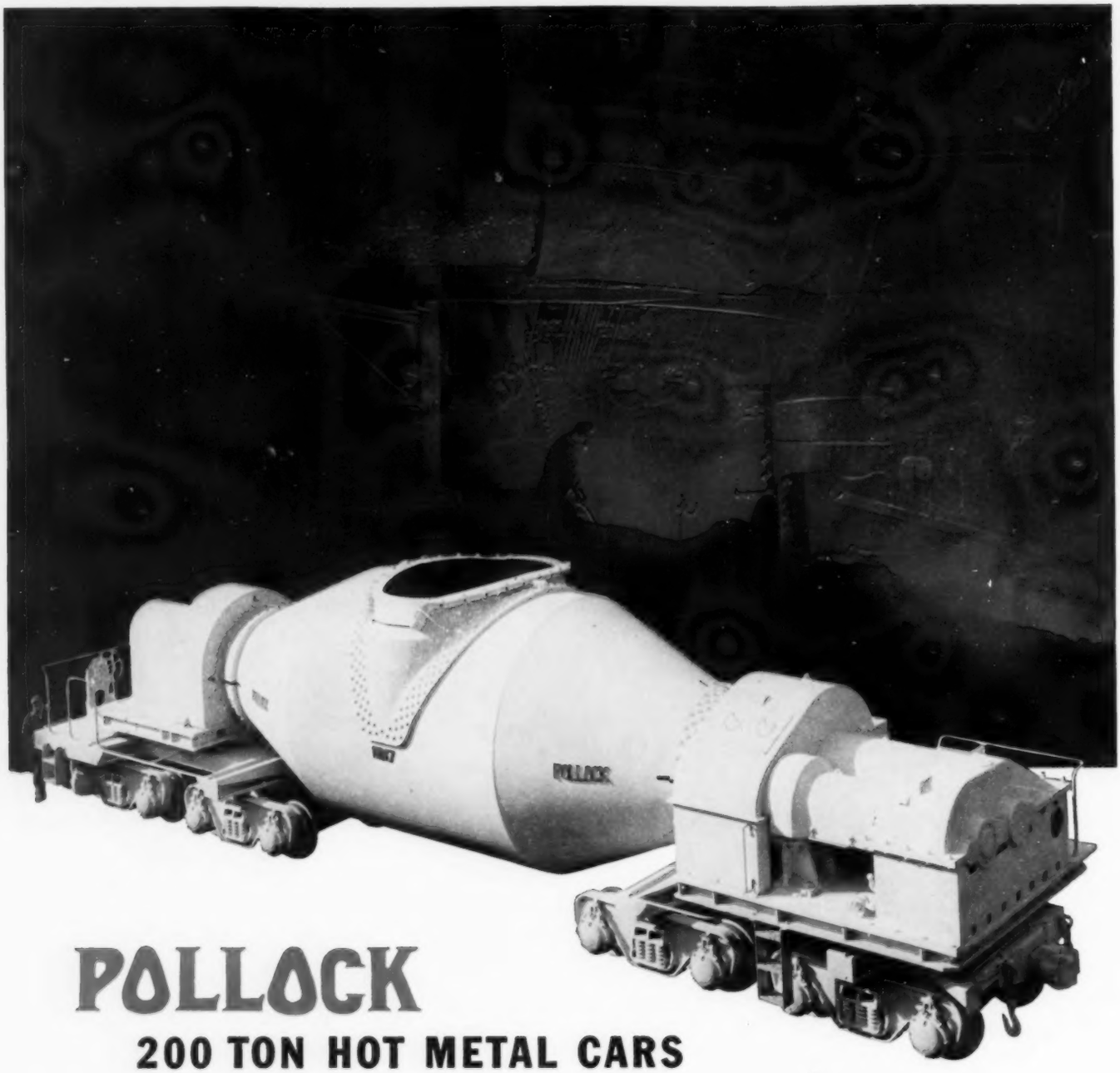
MANUFACTURERS OF: FULLY AUTOMATIC GEAR GRINDING MACHINES • THE DETROIT SCREWMATIC 750



POLLOCK

200 TON HOT METAL CARS

Engineered for U. S. Steel's Fairless Works

● Four engineering advances set this newest Pollock hot metal car apart from ordinary cars. First: Main bearings, self-aligning by spherical bushings, eliminate binding when operating on rough or uneven tracks. Second: Welded steel car bodies and ladles. Third: Main bearings lubricated on bottom halves with grease pressure pumps. Fourth: Gear reducer on the tilting drive has pump lubrication to all gears and bearings.

This car was designed and built by Pollock to meet the particular requirements of the Fairless blast furnace and steel plant.

Pollock has supplied equipment to the iron and steel industry for 92 years. Let them help you analyze your heavy equipment needs.

Dumping mechanism with protecting covers removed.

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THE WILLIAM B. POLLOCK COMPANY
YOUNGSTOWN, OHIO

STEEL PLATE CONSTRUCTION • ENGINEERS • FABRICATORS • ERECTORS

BLAST FURNACES • HOT METAL CARS AND LADLES • CINDER AND SLAG CARS • INGOT MOULD CARS • CHARGING BOX CARS • WELDED OPEN HEARTH LADLES

GENERAL ELECTRIC ANNOUNCES . . .

NEW 50,000-KVA E-1 MOTOR STARTER

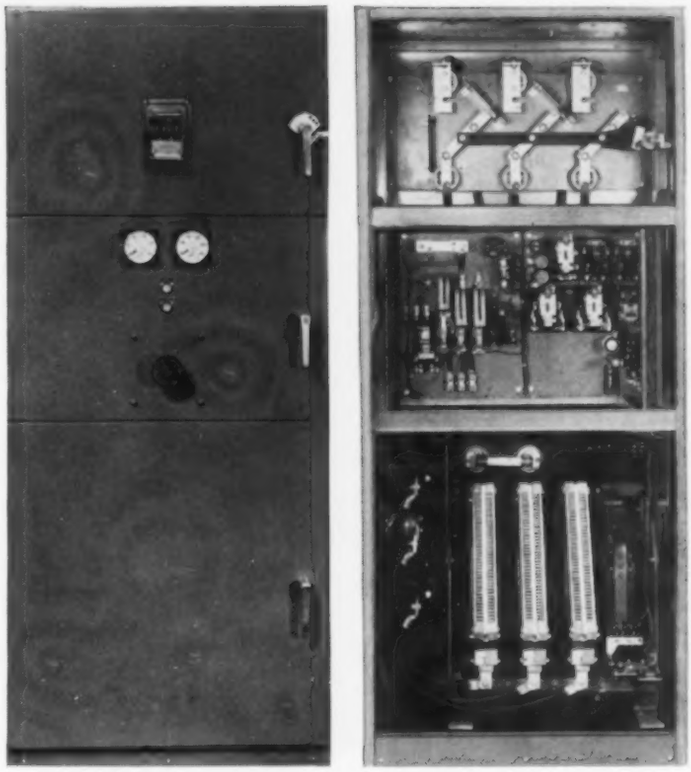
General Electric's all new 50,000-kva, air-break motor starter utilizes the 50-mva interrupting ability of its contactor for fault interruption. This new Class E-1 starter combines dependable performance with these other outstanding features:

- **Increased Personnel Safety**—entrance to the high-voltage compartments is impossible until the unit has been de-energized.
- **Easy Installation**—contactor may be rolled in or out of unit, and all connections are made from front.
- **Space Savings**—small cabinet (30 in. deep, 38 in. wide, 90 in. high) plus elimination of need for back aisle.

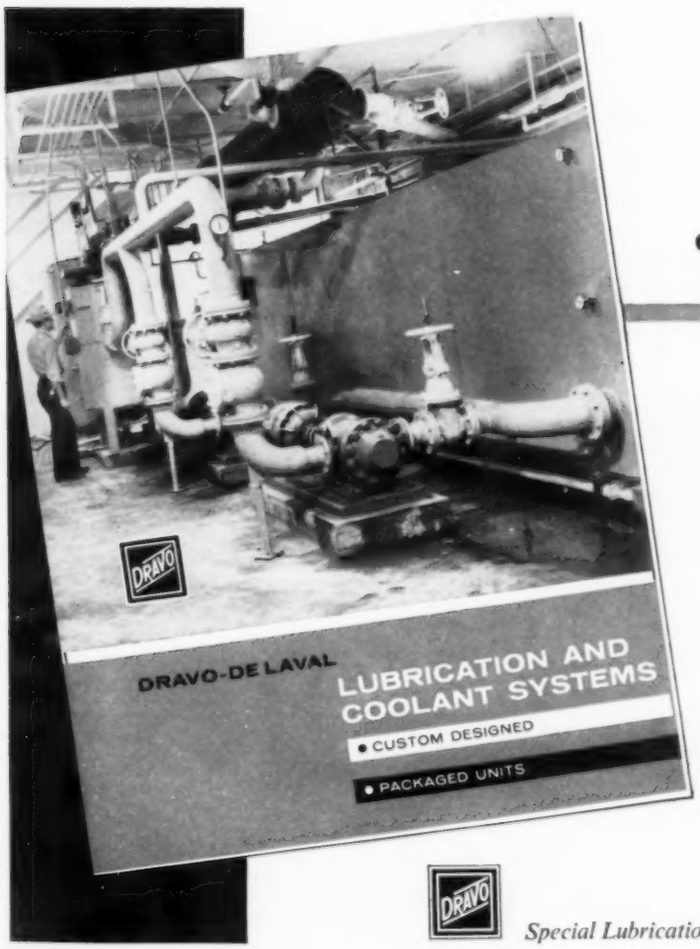
This new General Electric starter is designed to handle 2300 to 4600 volts for motors up to 3000 hp. Unit contains no power fuses; however, for interrupting capacities over 50,000 kva, fuses can be added.

Contact your G-E Apparatus Sales Office, or write Sect. 783-5, General Electric Co., Schenectady, N. Y. *Industry Control Department, Roanoke, Virginia.*

GENERAL ELECTRIC



New G-E starter provides 50-mva interrupting capacity without fuses, increases personnel safety, minimizes floor-space needs.



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Custom Designed or "Packaged" Units

Dravo-DeLaval systems combine engineering skill with broad experience to produce lubrication and coolant systems that are dependable and efficient.

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DRAVO CORPORATION

Special Lubrication and Cooling Systems for mechanical equipment serving industry

INSULATING FIRE BRICK	Temp. Limit	Density (lb/cu ft)	Strength (cold crushing, psi)	Conductivity (Btu in. sq ft F hr at 1000F mean temp)
JM-3000	3000F*	64	400	3.20
JM-28	2800F*	58	150	2.50
JM-26	2600F*	48	190	2.22
JM-23	2300F*	42	170	1.91
JM-20	2000F*	35	115	1.22
JM-1620	1600F* / 2000F**	29	70	1.02
Sil-O-Cel Super	2500F**	40	300	1.95
Sil-O-Cel C-22	2000F**	38	700	1.88
Sil-O-Cel 16L	1600F*	34	350	1.07

*Back-up or exposed
**Back-up only

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insulating fire brick with balanced properties for unsurpassed heat-control effectiveness

The nine types of insulating fire brick produced by Johns-Manville offer furnace builders and operators a common advantage—*balanced properties!*

The Johns-Manville insulating brick formulated for your service gives you the ideal combination of physical and thermal properties without sacrificing one for the other. This means you get unsurpassed heat-control effectiveness . . . greater economy in furnace design . . . hours saved in reaching operating temperatures!

For a good example of the value of *balanced properties*, take the proved performance of JM-3000 insulating fire brick. Formulated for 3000F temperature service, this insulating fire brick has unusual load bearing strength, high spall resistance, low shrinkage and thermal conductivity proportionate to its density.

Johns-Manville has two strategically located plants for the production of insulating brick: Lompoc, California and Zelienople, Pennsylvania. Insulating brick are available from the stocks of authorized J-M distributors in key industrial areas.

For complete information, call your nearest J-M representative. Or write for brochure IN-115A to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

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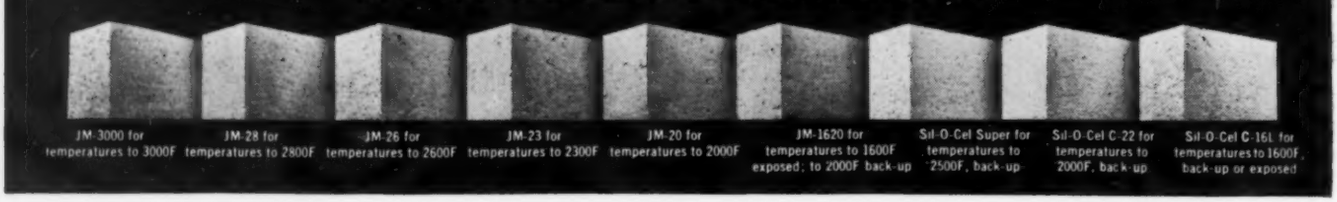
THE INDUSTRY'S MOST COMPLETE LINE OF INSULATING FIRE BRICK


JM-3000 for temperatures to 3000F
JM-28 for temperatures to 2800F
JM-26 for temperatures to 2600F
JM-23 for temperatures to 2300F
JM-20 for temperatures to 2000F
JM-1620 for temperatures to 1600F exposed; to 2000F back-up
Sil-O-Cel Super for temperatures to 2500F, back-up
Sil-O-Cel C-22 for temperatures to 2000F, back-up
Sil-O-Cel C-16L for temperatures to 1600F, back-up or exposed

CONTROLLED SPEED
DOUBLE COOLING

NO SLIP
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NO TWIST

-Better Wire!

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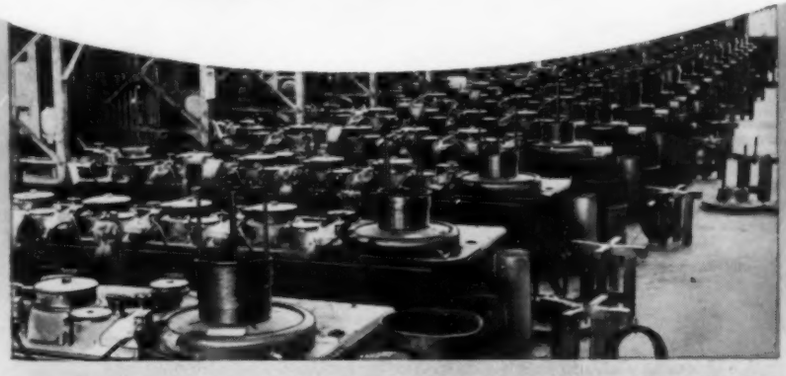

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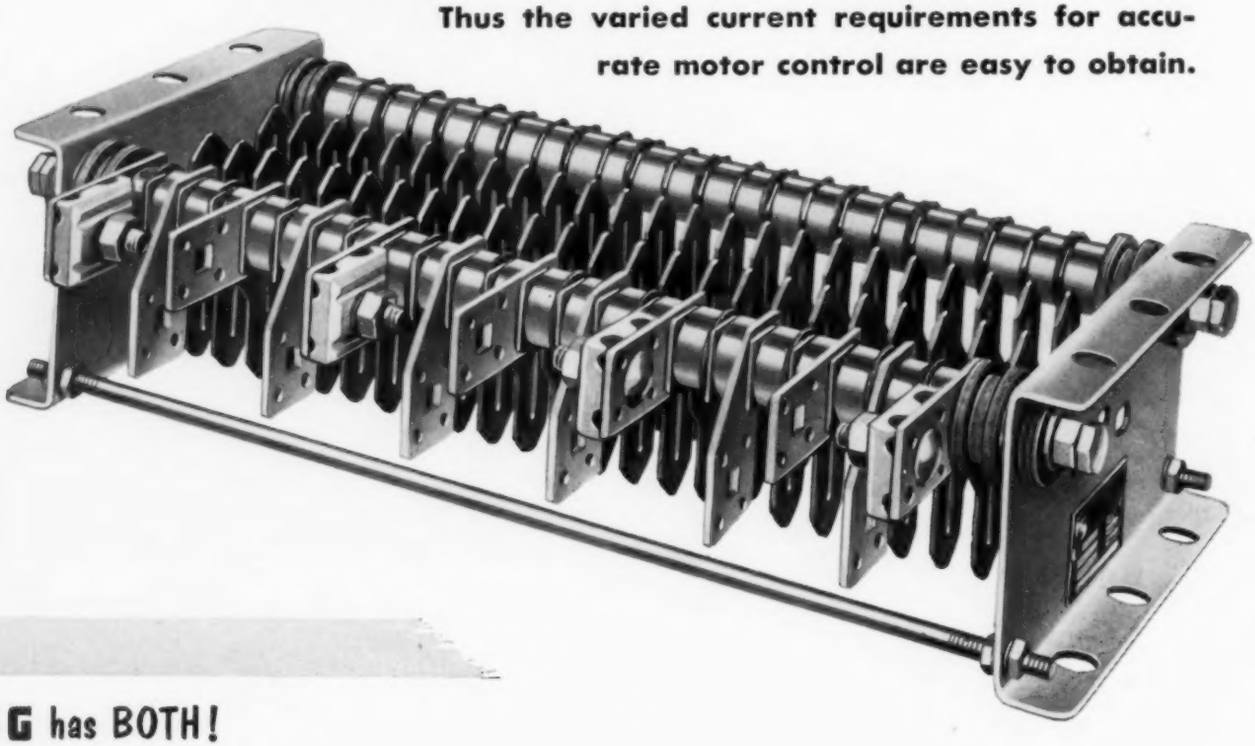
Because the resistance grids used for P-G STEEL GRID RESISTORS are produced in a great number of specific resistance values. Thus the varied current requirements for accurate motor control are easy to obtain.



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Flexibility in meeting current requirements, enables P-G Steel Grid Resistors to have *both* correct ohmic values as well as required capacities for each application. Naturally, this ability assures accurate *motor control*. Specify P-G for your next application.

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Pictured here are a few of the many Wire Flattening Mills designed and built by Waterbury Farrel. Each installation was custom-engineered to fit the production requirements of each individual customer.

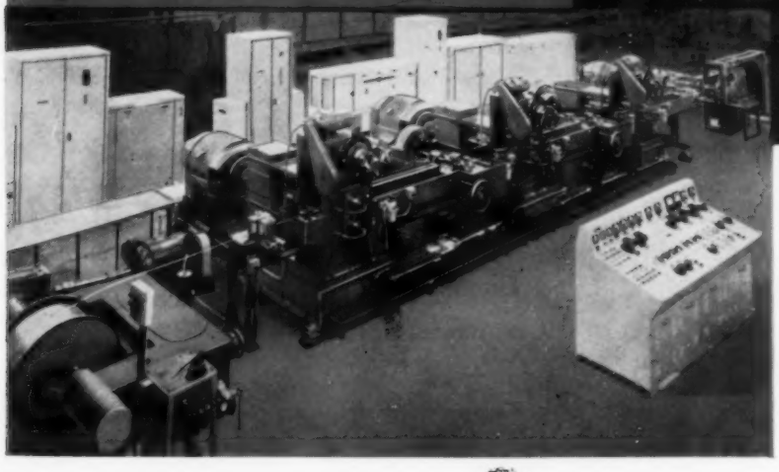
Whether your requirements call for a single or multiple stand mill, Waterbury Farrel can supply you with a reliable production unit that will prove to be a profitable investment.

Two Stand Tandem Wire Flattening Mill at National Electric Coil Co., Columbus, Ohio. Speeds up to 1000 feet per minute.

Two Stand Tandem Wire Flattening Mill recently installed at John A. Roebling's Sons Corp., Trenton, N. J. Speeds up to 1500 feet per minute.

Three Stand Tandem Wire Flattening Mill in production for Anaconda American Brass Co. Ltd. (Subsidiary of the American Brass Co.) New Toronto, Ontario, Canada. Speeds up to 1800 feet per minute.

Three Stand Tandem Wire Flattening Mill installed at General Electric Co. in their Pittsfield Works. Speeds up to 2500 feet per minute.



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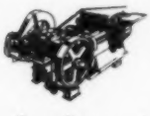

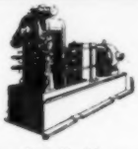

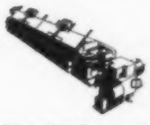

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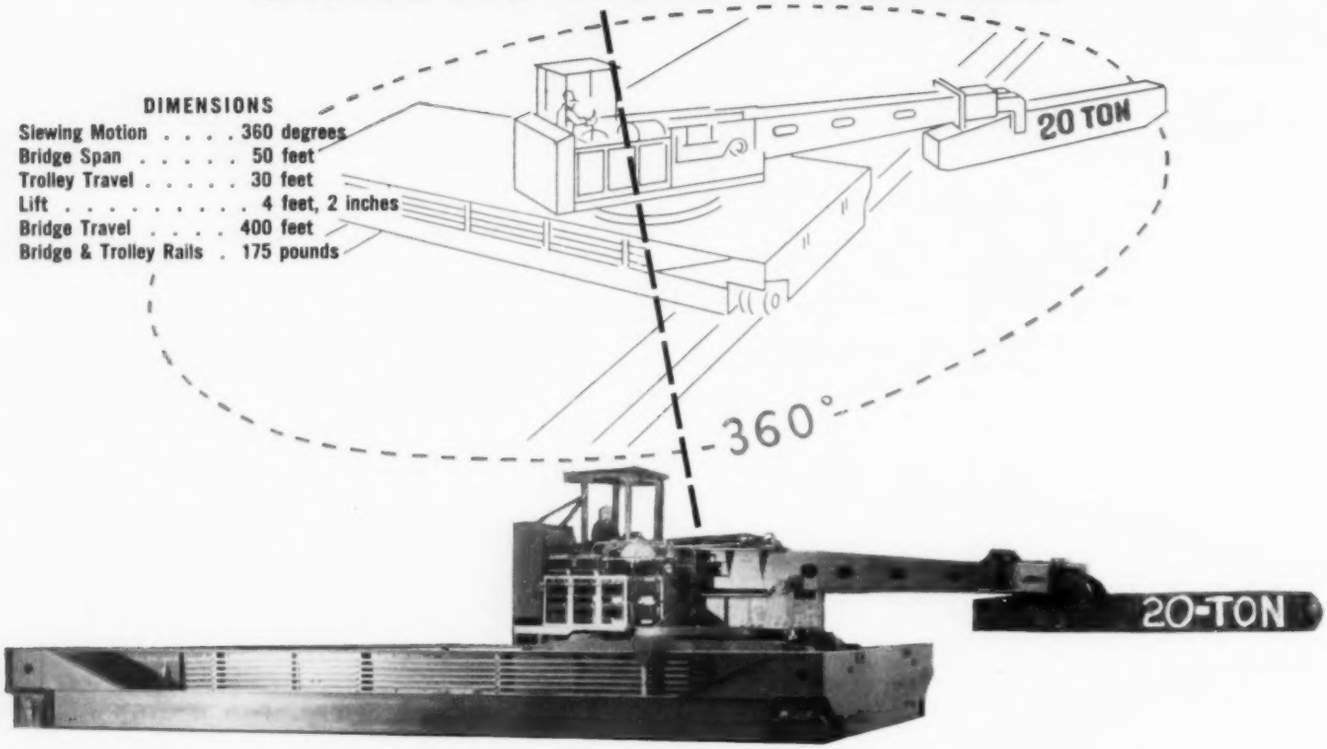
Bolt, Nut & Screw Machinery • Power Presses • Rolling Mill Machinery • Wire Mill Equipment • Sendzimir Mills and other Special Machinery

WF-32

Swinging 20 TONS OF INGOT ON A 28-FOOT RADIUS


DIMENSIONS
Slewing Motion . . . . 360 degrees
Bridge Span . . . . . 50 feet
Trolley Travel . . . . . 30 feet
Lift . . . . . 4 feet, 2 inches
Bridge Travel . . . . 400 feet
Bridge & Trolley Rails . 175 pounds
20 TON
360°
20-TON

New *Alliance* floor type ingot charging machine

● An ingot charging machine must have great mass and stability to skew 360° with a 20-ton ingot gripped in the peel at 28-foot radius. The hoist must also be of sufficient capacity to handle this tremendous cantilever load. The Alliance ingot charger shown here weighs 400,000 pounds, and is installed in one of America's largest forge plants. . . . The rigid cast steel upper revolving frame turns on conical rollers which operate in a bath of oil. These rollers are supported on one-piece cast steel lower frame. Trolley and bridge move smoothly, each on eight rolled steel track wheels housed in cast steel compensating trucks, a design that reduces wheel loading to a minimum. . . . Alliance builds the equipment to move slabs, ingots, hot metal, raw materials and finished products safely, quickly and easily. For 50-odd years, plant and steel mill engineers have taken their handling problems to Alliance — World's Largest Builder of the World's Largest Cranes.

"Give us the Runway and we'll lift the World"

THE *Alliance* MACHINE COMPANY

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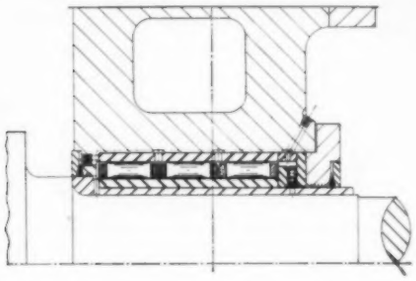
Equipment News...

BEARING ASSEMBLY

▲ Designed by Rollway Bearing Co. for 14-in., 30-in., 42-in. four high mills, is a bearing assembly consisting of single-acting thrust bearing (right), and special rollneck radial bearing (center).

The "three-in-one" roller bearing, which backs up load from rotating work rolls, has a radial load capacity of 285,000 lb at 41 rpm. Three sets of 24 rollers, $\frac{7}{8}$-in. diameter by $2\frac{3}{8}$-in. long, are housed in separate machined bronze retainers and enclosed by $9\frac{1}{2}$-in. wide inner and outer races. Oil holes, located in outer race between retainers, insure proper lubrication. Bearing is completely separable, with straight races. Bearing OD is 12 in., with 8-in. bore.

Outside plate of Rollway T-Type thrust bearing (right) is ground



for stationary slip-fit in housing. Special locating sleeve in housing maintains proper location of adjoining radial bearing's outer race. Extremely close parallelism of thrust plates yields maximum linear contact. Brinell effect frequently encountered with ball thrust bearings, particularly at lower speeds, is thus eliminated.

Bearing capacity, size and design may be modified to customer specifications.

POSITIONING SYSTEM

▲ Announced by The Bristol Co. is a new remote positioning system for transmitting motion with appropriate output power. The system is composed of three basic components: a transmitter, amplifier and receiver.

The system has been designed for maximum reliability, and will either operate under any statistically reasonable failure, or will remain in position. It will never allow an undesired signal to move the output shaft. Any form of motion can be transmitted or received, either linear or rotary. Power supplies of amplifier and receiver need not be identical; amplifier requires 115 v, 400 cps supply, but the receiver motor may operate on practically any power supply available. Input-output ratio can be 1:1 or any other desired ratio.

Accuracy of the system is independent of load, since the receiver motor gets full voltage for any error signal exceeding the deadband, which can be as low as 0.2 per cent of scale. Manual over-ride, inching control and interlock features are available as options.

Applications for the new systems include such operations as fuel mixture and throttle control on engine test cells, valve operation in process work and remote manipulation in radioactive or hazardous locations.

SPECIAL CAR CUTS ELECTRODE UNLOADING COST

The Electrode Division, Great Lakes Carbon Corp. in conjunction with Southern Railway System, has been using gondola cars equipped with specially designed bulkheads. The two organizations report that costs of unloading electrodes can be cut up to 80 per cent, and not only does it take fewer men less time to unload the new electrode car, but there is less dunnage, and shipments travel more safely. A unique feature of the gondola is a movable bulkhead which can be adjusted according to size of the shipment. At opposite end of the car is a stationary bulkhead with a sliding wedge device which automatically adjusts forward to take up slack as it develops en route. Shipments are palletized at the plant to expedite loading and unloading. Load distribution in the special gondola also provides stowage for nipples.

STARTERS

▲ A new line of NEMA Class E-1 high-voltage air-break starters with an interrupting capacity of 50 MVA has been announced by the General Electric Co.'s Industry Control Department.

A contactor has replaced current-limiting fuses to provide interrupting capacity in the new line, thereby eliminating the fuse-replacement problem. GE engineers say that, when the need for increased interrupting capacity arises, the starter may be easily and inexpensively converted to provide a maximum interrupting capacity of 150 MVA at 2300 volts and 250 MVA at 4000 or 4600 volts. The line can be

You're SAFER

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ALLOY SLINGS!

TAYLOR uses

GAMMA RAY

QUALITY CONTROL

on master, joiner and end links...

CONTROLLED-ATMOSPHERE HEAT-TREATING

on popular chain sizes...

New, patented

TAYCO HOOKS!

Pat. No. 2,646,306—7/21/53

Famous TM factory made Alloy Sling Chains are tougher—safer! The use of Gamma Ray assures flawless, trouble-free welds on master, joiner and end links. This, in addition to our rigid standards... Controlled-Atmosphere Heat-Treating of popular sizes... patented Tayco Hooks and other superior production techniques, makes TM factory made Alloy Slings a better buy!

Call your INDUSTRIAL DISTRIBUTOR today for your free copy of Bulletin No. 13!

TAYLOR MADE

A GREAT NAME IN Chain SINCE 1873

S. G. TAYLOR CHAIN CO., INC.

A complete line of quality chain!

Main office and plant—Hammond, Ind.

Eastern sales office and plant—

3505 Smallman St., Pittsburgh, Pa.

advantageously applied in any plant where a high-voltage starter is needed and the available power supply is limited to 50 MVA or less.

For use on utilization voltages of 2300 to 4600 volts, the new starter incorporates the best features of GE Limitamp controllers. It is entirely front-connected, requires a minimum amount of floor space (30 in. deep x 38 in. wide x 90 in. high), has a roll-out contactor, gang-operated disconnect switch and a maximum rating of approximately 3000 hp at 4600 volts.

MARKING HEAD

▲ Pannier Corp. announces a newly designed marking head for the single-stroke pneumatic markers. The new marking head incorporates a fast-change magazine style typeholder that allows users to change entire type setups, quickly, easily and safely. Pre-set type is now economically possible. In a matter of seconds, a type magazine with an all new type setup, can be inserted into the marking head, much like a cartridge magazine slips into a rifle.

The type magazine is made to accommodate lines of interchangeable characters positioned per specifications. Type face always strikes marking surface squarely to assure clean, clear-cut marking, because the new marking head is self-aligning by "type touch," even when marking surface is slightly out of square. Type is held securely in magazine by built-ins and handling convenience.

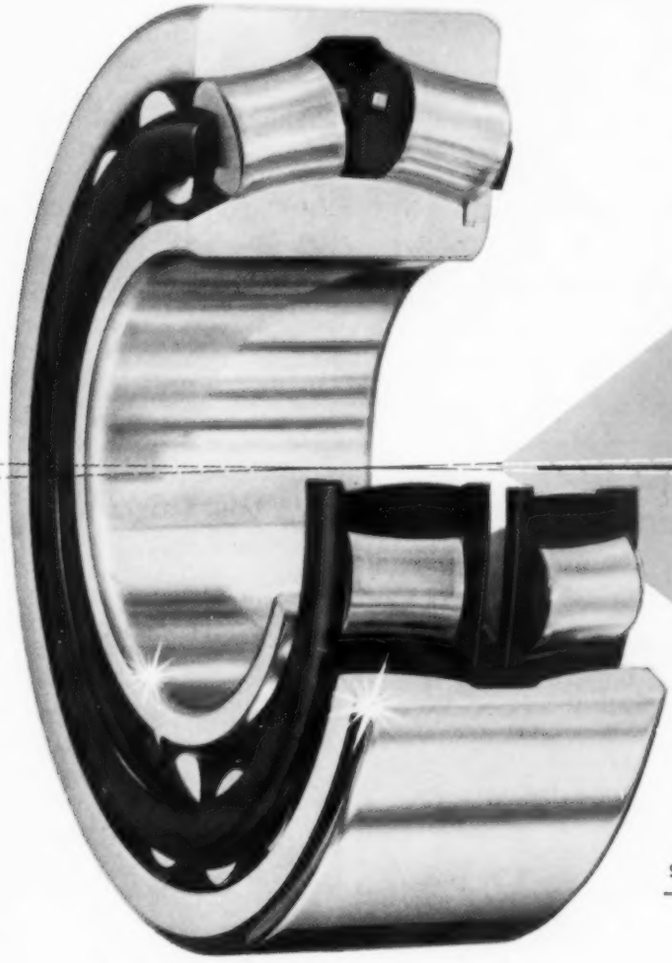
LIFT TRUCK

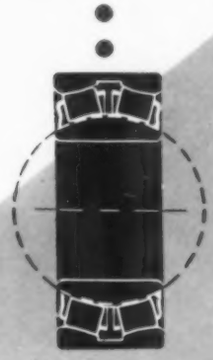
▲ Hyster Co. has announced a lift truck with greater power and faster, easier operation features. Increased versatility is also reported with the addition of new optional job attachments and gas installations.

High torque characteristics and increased horsepower is provided by a new 4-cylinder air-cooled engine. Improved operating ease and speed result from a repositioned instrument panel, improved upright design and use of constant mesh transmission. With dental clutches, instead of sliding gears, the constant mesh transmission gives longer life and easier, smoother shifting.

UL approved LP-gas equipment is

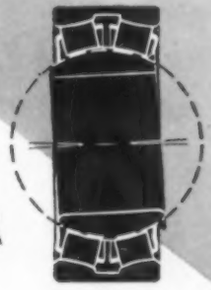
Self-aligning TO KEEP ITS CAPACITY IN ROUGH, RUGGED SERVICE





THIS IS SELF-ALIGNMENT. Spherical inner ring is free to align itself in any direction. Thus . . .

FULL LOAD CAPACITY is always assured, regardless of shaft deflection or misalignment.



Series 22200 and 22300 —22500-A and 22600-A roller bearings

Spherical LINK-BELT roller bearing compensates for shaft deflection, weaving of supports

MANY leading makers of tough duty equipment now design without bulky supports to prevent deflections. They're using this spherical Link-Belt roller bearing that *compensates for misalignment* . . . always keeps its full capacity for handling radial and thrust shock loads without "pinching."

In addition, it's factory-adjusted, easy to mount and available everywhere with internationally standardized boundary dimensions.

Link-Belt also makes industry's most complete line of ball and roller bearing blocks. They're all in Book 2550—yours for the asking at any Link-Belt office or Authorized Stock-Carrying Distributor. 14.443-A

LINK-BELT

self-aligning ball and roller bearings

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

Protects Metals at Red Hot Temperatures!

UP TO 2200°F

Heatproof Coating Stops Corrosion, Scaling and Oxidation

MARKAL "S-R" Coatings were developed to protect metals, graphite or carbon parts against scaling, corrosion, oxidation, or carbon and hydrogen penetration at temperatures up to 2200°F. MARKAL "S-R" Coatings are excellent for the protection of stacks, radiant tubes, retorts, carburizing grids, mufflers, manifolds, etc.

MARKAL "S-R" Coatings will not peel or crack at high temperatures and are not affected by rapid heating and cooling cycles.

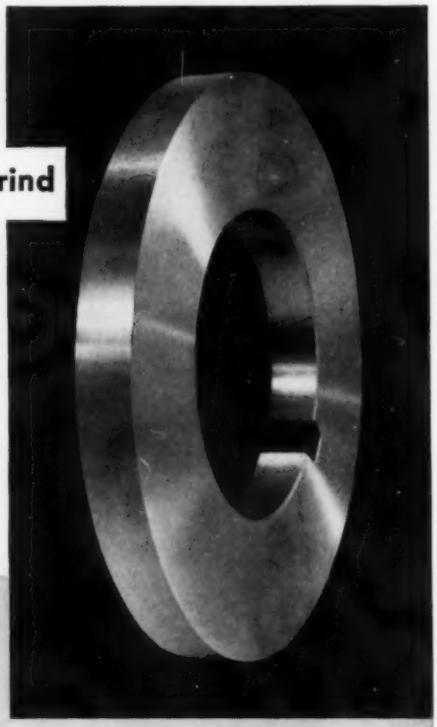
MARKAL Coatings are manufactured in a complete range of types for specific applications. Write for a free copy of Catalog MPC. The MARKAL COMPANY, 3087 W. Carroll Ave., Chicago 12, Illinois.

COWLES

TRIMMING KNIVES

produce more tonnage per grind

Cowles knives stay on the job longer. They keep mills in continuous production without downtime for knife changes. Manufactured from individually hammered forgings, and heat treated to assure maximum durability, they meet industry's most exacting requirements. Complete range of sizes. **Prompt delivery.** Widely used by all principal producers and processors. Let us quote on your requirements!



COWLES
TOOL COMPANY

2086 WEST 110th STREET
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Specializing in the Manufacture of

ROTARY SLITTING KNIVES • SPACING COLLARS • GANG TOOLS • EDGING ROLLS • CUT-OFF KNIVES • SEAM GUIDE ROLL FINS • SEAM GUIDES • WIRE DRAWING TOOLS • STANDARD AND SPECIALLY ENGINEERED TOOLS FOR ALL FERROUS AND NON-FERROUS PROCESSING, TRIMMING AND FORMING REQUIREMENTS.

now optional for this truck. LP-gas operation gives increased engine life, longer oil and oil filter life, lower fuel costs, lower maintenance costs and reduction of exhaust fumes.

ELECTRODE

▲ Announced by Air Reduction Sales Co. is a new general purpose electrode which meets the A.W.S. and A.S.T.M. E-6013 classification. It is a heavily coated electrode of moderate arc force designed to operate in all positions on a-c or d-c.

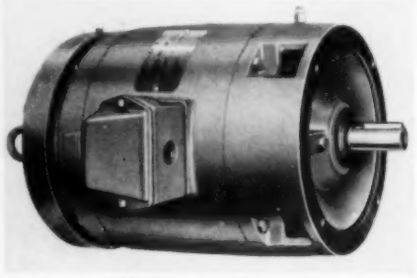
The electrode is particularly useful for welding mild steel to medium carbon and low alloy steels. In addition to high mechanical and impact properties, the finished bead is free of surface depressions common to this type of electrode.

It is recommended for general purpose use as small diameters are readily acceptable for light gage work while the larger diameters produce good welds on heavy sectioned weldments.

MOTORS

▲ Reliance Electric and Engineering Co. has announced a complete line of totally protected, vertical solid shaft P-base motors for all vertical pump installations.

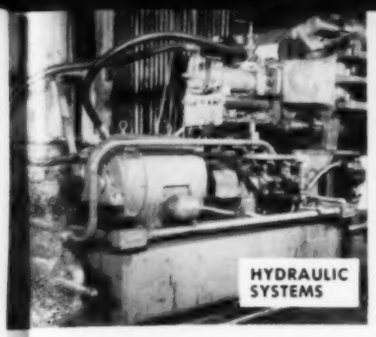
The new motors, with normal thrust bearings in all sizes from 1 to 40 hp and high thrust in sizes from 1 to 15 hp, are available in protected,

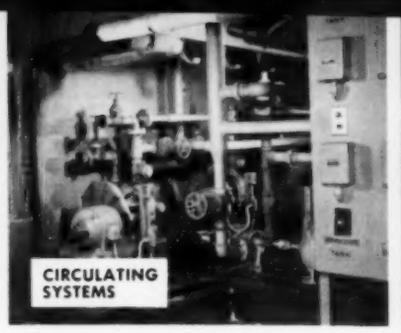


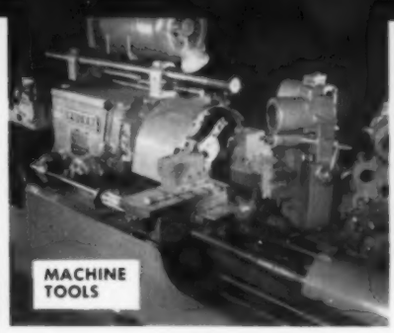
totally enclosed, or explosion-proof enclosures. The standard enclosure for these explosion-proof P-base motors meets Underwriters' Laboratories specifications for performance under conditions covered by Class I, Group D, and Class II, Groups E, F and G.

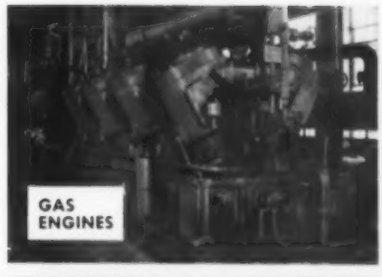
Designed for indoor and outdoor installations, all of these motors are corrosion-proof for long, safe operation under adverse conditions as are frequently found in the process industries. The shaft is sealed by a neoprene slinger that protects bear-

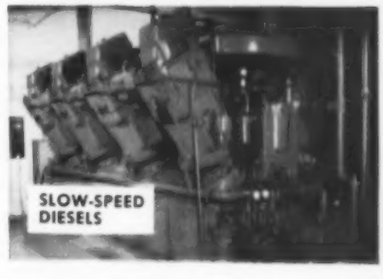
(*Please turn to page 237*)











SUN SOLNUS OILS IDEAL LUBRICANTS FOR 80% OF ALL APPLICATIONS

Moderately priced...low in carbon-forming tendencies, Sun Solnus® oils simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several.* Their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price all add up to "more lubrication per dollar."

For technical information, see your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-51.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

PHILADELPHIA 3, PA.

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In Canada: SUN OIL COMPANY LIMITED, Toronto and Montreal

Valve on left is from compressor run for 3,000 hours with well-known, high-grade oil. At right is same valve after a 3,000-hour run with Sun Solnus oil. Note difference in carbon deposits.

3000-HOUR TEST PROVES SUN SOLNUS OILS REDUCE CARBON BUILD-UP IN COMPRESSORS

Equipment: A three-stage Norwalk horizontal-type compressor. Operating pressure: from 1,000 to 1,500 psi.

Test: The compressor was cleaned thoroughly and filled with a well-known, high-grade oil. The equipment was run for 3,000 hours, then torn down for inspection and cleaning. Then Solnus® 300 was tested in the same way.

Results: Look at the two pictures. You can see for yourself how Solnus oil reduced dangerous carbon build-up.

All types of reciprocating air compressors that have been changed over to a Sun Solnus oil show similar results. A test in your compressor will show the same remarkable reduction of carbon deposits.

You can get a technical bulletin about Sun Solnus oils by asking your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-52.

SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

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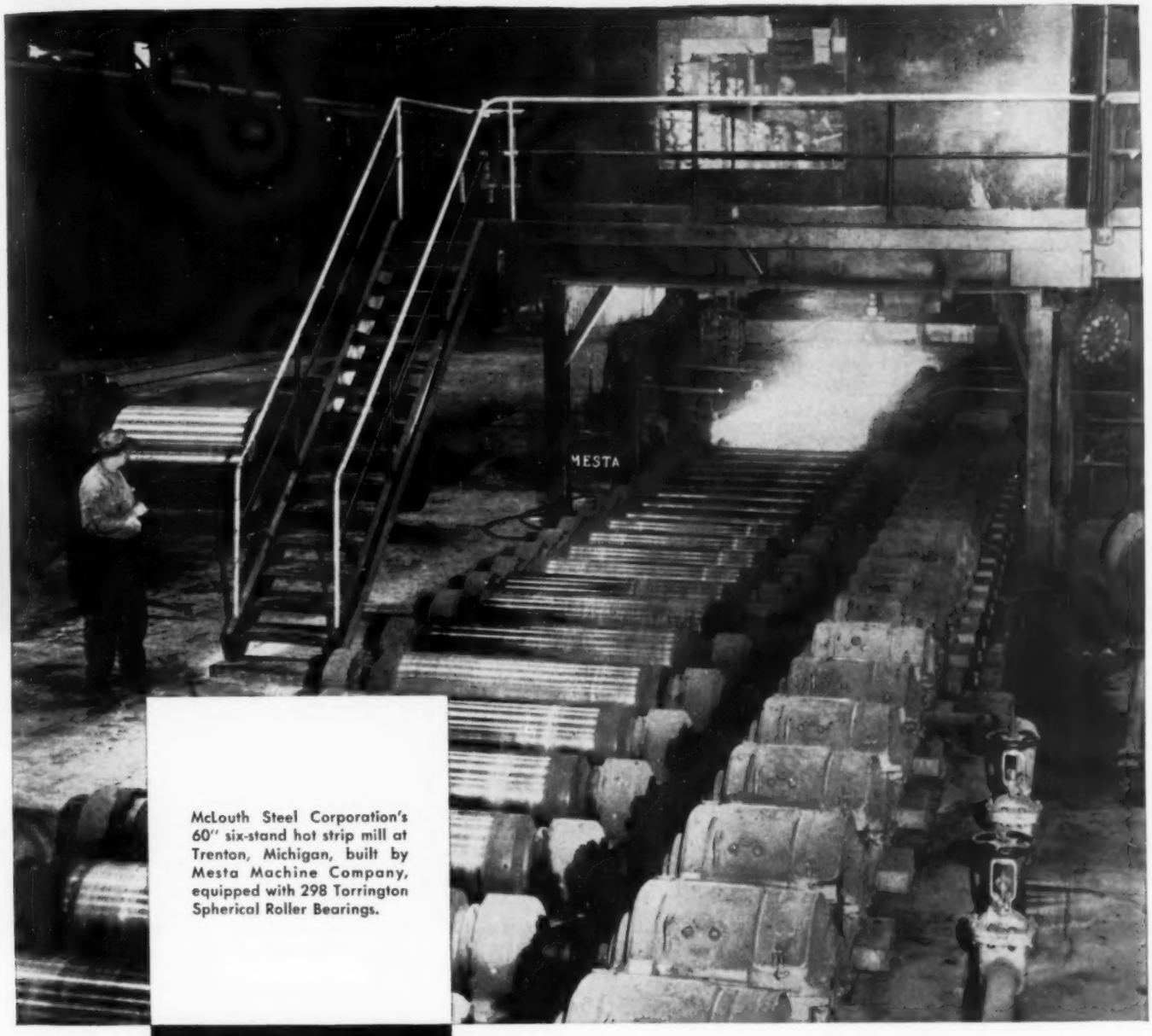
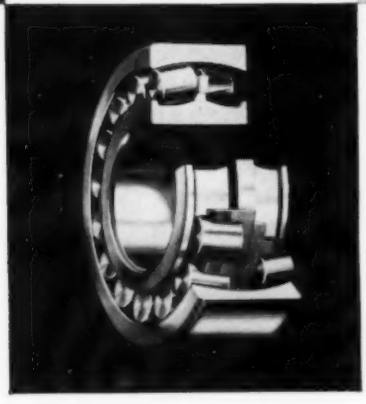


McLouth Steel Corporation's 60" six-stand hot strip mill at Trenton, Michigan, built by Mesta Machine Company, equipped with 298 Torrington Spherical Roller Bearings.



Self-driven table rolls mean drastic cut in mill down time!

It was a new idea. Suppose mill approach and runout table rolls had their own independent motors and pillow blocks instead of conventional gearing and line shafts? Then any roll could be removed for maintenance and replaced immediately by a stand-by assembly without shutting down the whole table for hours!

Torrington engineers, working with Mesta engineers, came up with a design mounting Torrington Spherical Roller Bearings in Torrington-built fixed and floating pillow blocks. These bearings compensate for misalignment across the table and for dynamic deflection of the rolls under load. In both roughing and finishing mill tables, 298 Torrington Spherical Roller Bearings have been operating efficiently since 1954!

The Torrington Company, with experience in the manufacture of every major type of anti-friction bearing, has made thousands of installations in steel mill equipment that have helped roll record tonnages. Your Torrington engineer is an expert: call on him when you need help. *The Torrington Company*, South Bend 21, Ind.—Torrington, Conn.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • NEEDLE • BALL • NEEDLE ROLLERS • THRUST

The unique air-blast test device shown above makes possible one of the most accurate accelerated spalling tests in the basic refractories industry.

Following is an example of how Kaiser Chemicals research laboratories use the test to help develop Periclase Chrome brick with stronger bonds, lower thermal expansion and higher conductivity (the three "musts" for spall-resistant brick):

"Whistling Wind" Creates Heat Differential

First, 3″ x 3″ x 6″ samples of pre-fired brick are placed in a furnace and brought up to test temperature.

Next, the samples are removed from the furnace and placed immediately in the test device. Unheated insulating brick cover all sides and the bottom of each hot sample, leaving only one 3″ x 3″ end of each brick exposed.

Then, high-pressure jets of cold air are blown directly onto the exposed ends of the glowing bricks. This "Whistling Wind" air blast shock-chills one end of each brick . . . while the rest of the brick remains red-hot!

Tests Brick's Ability to Resist Spalling

After a measured air-blast cooling period, the bricks are inspected and cracks (if any) recorded. The bricks are then placed in the furnace again to repeat the cycle. A record is kept for each test cycle, and failure is recorded when a brick separates.

Research Lengthens Brick Service Life

This unusual test is just one example of the thoroughness and originality of Kaiser Chemicals Research. From it—and from many other unique tests—come special refractory compositions such as Kaiser Periclase Chrome brick that assure open hearth operators of less spalling, less swelling and greater resistance to alteration by oxides and slags. Good reasons why more and more open hearth operators say:

"Kaiser Periclase Chrome Brick Last Longer"

For this unique spall test, "Whistling Wind" chill-blasts one end of each brick while the rest of the brick remains red-hot.

MORE REASONS WHY KAISER PERICLASE CHROME BRICK GIVES YOU BETTER SERVICE:

1. **Low Chromite Content.** Chromite content is the minimum amount necessary to provide thermal shock resistance, (only 9.1% Cr_2O_3). Lowering of chromite also reduces swelling in presence of iron oxide, thus minimizes buckling and peeling.

2. **Uniform High Strength** because the ceramic bond is formed *BEFORE* the chemical bond burns out.

3. **Outstanding Dimensional Stability** because there is no liquid phase in the conversion from chemical to ceramic bond. Nothing "melts out" to cause distortion or shrinkage.

4. **Excellent Resistance to Chemical Attack** by furnace fumes, iron oxides and slags is assured by high magnesium oxide content, maximum brick density, (low porosity), and chemically stable composition.

Call or write Kaiser Chemicals Division, Dept. S7431, KAISER ALUMINUM & CHEMICAL SALES, INC., at any of the addresses listed below.

PITTSBURGH 22, PA. . . . . 3 Gateway Center
HAMMOND, IND. . . . . 518 Calumet Building
OAKLAND 12, CALIF. . . . . 1924 Broadway

Kaiser Chemicals

Pioneers in Modern Basic Refractories

REFRACTORY BRICK & RAMMING MATERIALS • CASTABLES & MORTARS
MAGNESITE • PERICLASE • DEADBURNED DOLOMITE • ALUMINAS

Simplest pneumatic controller to use and maintain

Bristol gives you improved stability of control action –but keeps basic simplicity of Series 500 Controllers

Bristol Series 500 Pneumatic Controllers are the easiest controllers on the market to use and maintain–still the most dependable and trouble-free.

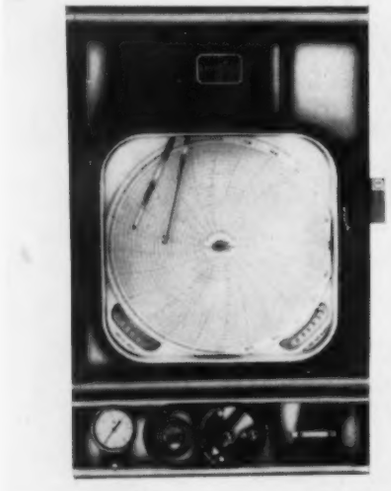
The reason? The basic simplicity of the operating mechanism. *That* hasn't changed in the years since we introduced this long-time favorite among instrument men. Reason No. 2: they are equipped with famous Bristol measuring elements.

Easy calibration

It's this foolproof simplicity of the control system that makes calibration so easy on Series 500 controllers. *Only one* service adjustment is required and provided to exactly calibrate the control system. The control system can be completely disassembled and after reassembly (even with replacement of parts) can be restored to precise calibration with this *one* adjustment.

No special tools are required. A ¼-inch wrench is all that's needed.

The 500's completely interchangeable parts, accurately designed and manufactured to extremely close tolerances, make possible this built-in calibration.



BRISTOL'S® SERIES 500 CONTROLLER, shown here with four-position transfer station. Internal station also available.

And check these features:

Improved control stability—advanced automatic control techniques have been applied by Bristol engineers to improve stability of control action in the new Series 500W Controllers.

Wide-band models offer choice of ½ to 400% proportional band with simple band shift.

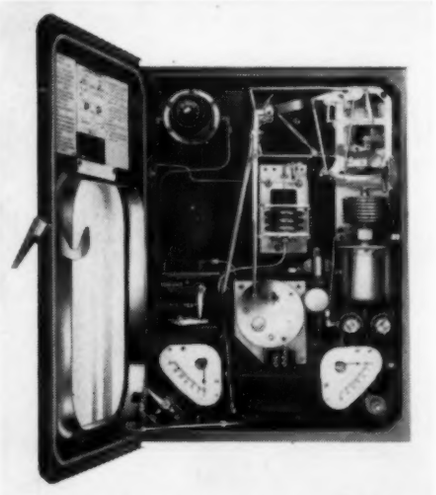
True zero derivative setting—exclusive with Bristol.

Reset action stops in reset models—again a Bristol exclusive—prevent loss of control due to prolonged deviation from set point.

Four-position internal transfer station with automatic, manual, test, and service positions, plus pressure-matching button and manual pressure regulator, for maximum convenience in process control.

Complete data available

Write today for engineering data on Bristol's Series 500 controllers for your critical control problems. They're available for *automatic control of temperature, pressure, vacuum, draft, absolute pressure, liquid level, humidity, pH value, electrical measurements, and mechanical motion.* The Bristol Company, 123 Bristol Road, Waterbury 20, Conn.



FOUR-POSITION INTERNAL TRANSFER STATION shown here in interior view of Series 500 Controller. Permits remote manual control, testing and servicing without disconnecting instrument.

YOU CAN GET THESE CONTROL MODES:

1. **Fixed narrow band** (on-off)
2. **Proportional band**—½ to 100% and ½ to 30%.
3. **Reset with wide band**—rates 0.1 to 10 or 1 to 300 repeats per minute. Proportional band ½ to 400%.
4. **Derivative (rate)**—½ to 100% proportional band. Derivative time 0.2 to 20 min., plus zero derivative setting.
5. **Reset plus derivative**—proportional band and reset rate as in "reset" above. Derivative time as in "derivative" above.

YOU CAN HANDLE THESE CONTROL PROBLEMS:

1. Cascaded control 2. Selective control 3. Ratio control 4. Time-program control 5. Pneumatic transmission.

6.55

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

(*Continued on page 230*)

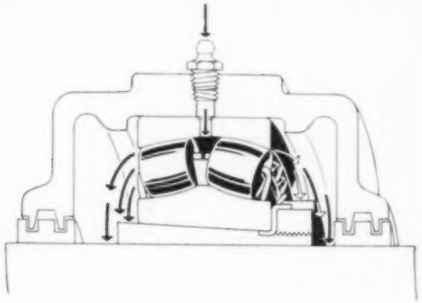
ings and windings from foreign matter. The mounting flange face and rabbet fits are machined after assembly to assure perfect mating with the pump flange and to provide positive shaft alignment for quiet, long-life operation. Exclusive Reliance lubrication automatically regulates the correct flow of lubricant to the bearings. Automatic grease relief prevents bearing damage from grease pressure or over-lubrication.

Other features of these motors include a corrosion-proof cast-iron frame and brackets, a cast-iron conduit box with gasketed cover and threaded conduit opening, sealed indexed leads and stainless steel nameplate.

BEARING LUBRICATION

▲ SKF Industries, Inc., announces a positive method to obtain the more efficient "center" instead of "side" lubrication of SKF spherical roller bearings.

This is accomplished by means of a groove machined around the circumference of the bearing outer ring. Equally spaced holes drilled in the ring, channel the lubricant from the groove to the center of the bearing. The lubricant, which is introduced through a fitting in the center of the housing cap, moves



along the groove and through the holes directly to the center of the bearing, where it does the most good. Thus, all working surfaces are quickly and completely covered with lubricant.

In addition, since the flow path of the lubricant is from the center to the sides of the bearing, the outward flow flushes away the old lubricant and, with it, any abrasive dust, dirt, moisture or other impurities. The effect of the fresh lubricant, therefore, is to keep the bearing clean as well as to lubricate it. Where circulating oil lubrication is desired, there is also a continuous flushing and cooling of the bearing.

SKF spherical roller bearings with this new method of lubrication can be used in any existing housing simply by drilling and tapping a new hole for the lubrication fitting in the center of the housing cap and plugging the original hole on the side.

Offered for the first time in spherical roller bearings, this design feature will make possible longer bearing service life at no additional cost to the customer, with resulting greater economy in the operation and maintenance of heavy duty equipment.

FORK TRUCK

Designed for use where severe operating conditions are encountered in day-to-day handling, a new 6000-lb-capacity heavy-duty fork truck has been introduced by the Elwell-Parker Electric Co.

As a stand-up model, the truck provides maximum ease of mounting

Lawrence COPPER COOLING PLATES

FOR TROUBLE FREE PERFORMANCE

Don't risk faulty cooling plates during your next campaign. Replace with Lawrence Copper Bosh and Mantle plates for dependable, trouble-free, long run performance.

Made from pure copper with the know how gained from 68 years in serving many of America's large steel plants, Lawrence Cooling Plates always last through the campaign. Send your specifications today.

Highest Quality and Dependability Since 1888

PURE COPPER CASTINGS
Tuyeres • Tuyere Coolers
Cinder Notches
Valve Gates and Seats

BRASS AND BRONZE CASTINGS
(Heavy type—1 to 2 ton)
Bearings • Machinery Bronze
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The drive unit consists of a motor vertically mounted and directly connected through a free coasting worm gear first reduction, spur gear second reduction. Drive shafts are mounted on taper roller bearings and are splined to a four-pinion differential.

Wheels are connected to drive shafts through forged clutch plates which are doweled and bolted to the cast steel wheels and splined to the drive shaft.

Book Review

"An Encyclopaedia of the Iron & Steel Industry" compiled by A. K. Osborne has recently been published by the Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. The book contains 558 pages, 6 x 9½, is cloth bound, and sells for $25. This encyclopaedia is not a textbook, its purpose is to provide a reference book, and contains in alphabetical order (from A to Z) descriptions of the materials, plant, tools and processes used in the iron and steel and closely allied industries, from the preparation of the ore to the finished product. It also defines the tech-

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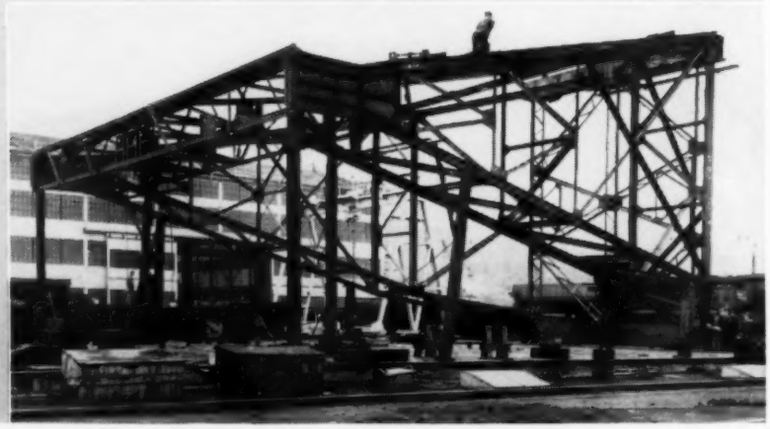

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nical terms employed. The book contains a flow sheet of the production of iron and steel; a section or chapter on new processes and supplementary data; and five appendices which cover conversion tables, weights and measures, properties of certain typical steels, effect of carbon on hardness of plain carbon steel, effect of tempering on plain carbon steel and alloy steel, and effect of mass on plain carbon steel and alloy steel; signs and symbols; and a list of scientific, technical and trade societies and other bodies related to the subject industry. The illustrations include nine diagrams and 16 photograph reproductions.

"Foundry Air Pollution Control Manual," covering material compiled and prepared by the Air Pollution Control Committee, of the American Foundrymen's Society, has recently been published by the AFS, Des Plaines, Iowa. The book contains 58 pages, 8½ x 11½ in. is cloth bound. This first engineering manual for control of air pollution from foundry operations provides foundry management with up-to-date information on how to evaluate an air pollution situation, engineer its control and maintenance, and select equipment and materials on the basis of local atmospheric and relation conditions. It deals with external foundry plant discharge, and its various sections cover, specifically, foundry industry's air pollution problem; review of existing ordinances; community relations; atmospheric sampling and analysis; air cleaning equipment; operation methods, improvements, and maintenance. Eleven tables and 49 illustrations amplify and explain the subject matter.

"Stress Corrosion Cracking and Embrittlement," edited by William D. Robertson, has recently been published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 202 pages, 9 x 6 in., is cloth bound, and sells for $7.50. This is a symposium arranged by the corrosion division of the Electrochemical Society, and contains fourteen papers from four countries, university laboratories and industry and is a representative sample of the recent thought that has been devoted to the mechanism of stress corrosion

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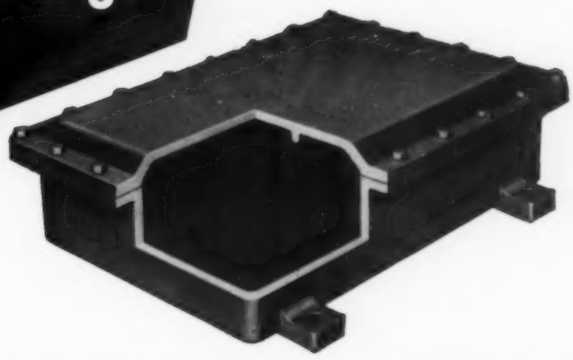

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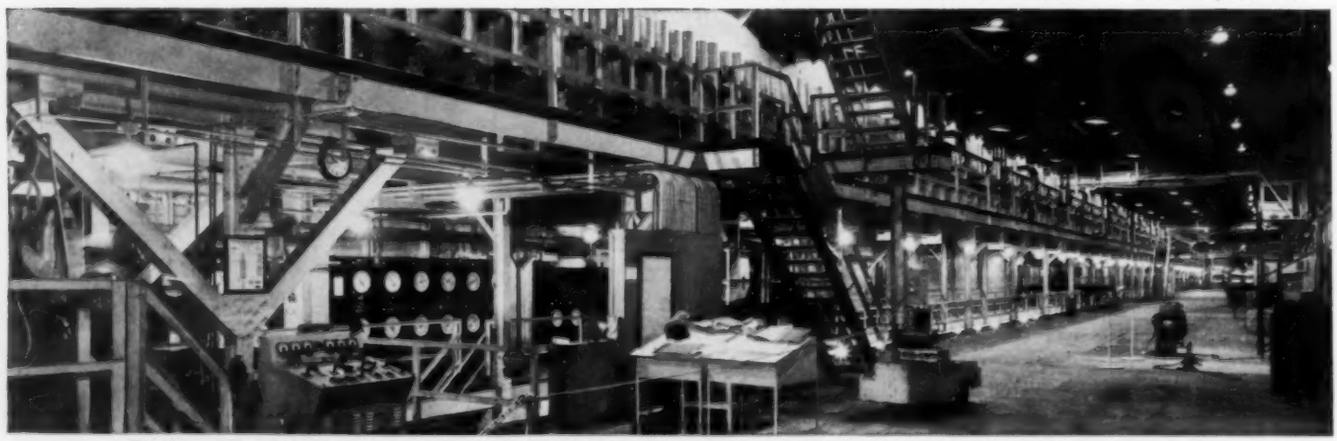

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cracking. Numerous line drawings and photographs are employed to illustrate the papers; and many references are listed.

"ASTM Standards On Zinc-Coated Iron and Steel Products" has been recently published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. The book contains 143 pages, 6 x 9 in., is heavy paper bound, and sells for $2.25. The compilation is sponsored by Committee A-5 on Corrosion of Iron and Steel, and includes all specifications under the jurisdiction of this committee as well as selected specifications written by Committee A-1 on Steel, A-2 on Wrought Iron, B-1 on Wires for Electrical Conductors, and B-2 on Non-Ferrous Metals and Alloys. The book contains 21 specifications (four new or recently revised); three recommended practices (2 new) and five methods of tests, on the following materials: wire, strands, fencing, sheets, hardware, tern-alloy-coated sheets and miscellaneous products.

"1956 Supplement to Book of ASTM Standards Including Tentatives," is now available from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. The supplement has seven parts, and costs $4.00 per part or $28.00 per set, in heavy paper covers. These include the following: "Part 1. Ferrous Metals," 440 pages, includes 48 standards (available January, 1957); "Part 2. Non-Ferrous Metals," 360 pages, includes 60 standards (available immediately); "Part 3. Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, and Soils," 300 pages, includes 57 standards (available January, 1957); "Part 4. Paint, Naval Stores, Woods, Sandwich Construction, Building Construction, Fire Tests, Wax Polishes," 230 pages, includes 78 standards (available January, 1957); "Part 5. Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes," 320 pages, includes 75 standards (available January, 1957); "Part 6. Rubber, Plastics, Electrical Insulating Materials," 380 pages, includes 71 standards (available January, 1957); "Part 7. Textiles, Soap, Water, Paper, Adhesives, Shipping Containers, Atmospheric Analysis," 220 pages, includes 34 standards (available immediately).

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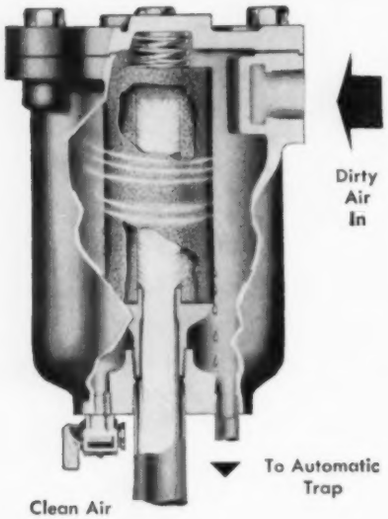

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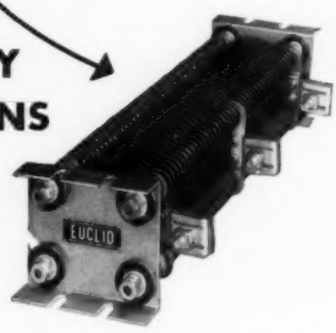

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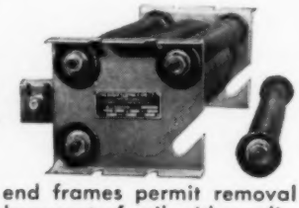

Slotted end frames permit removal and replacement of coil without disturbing rod assembly.

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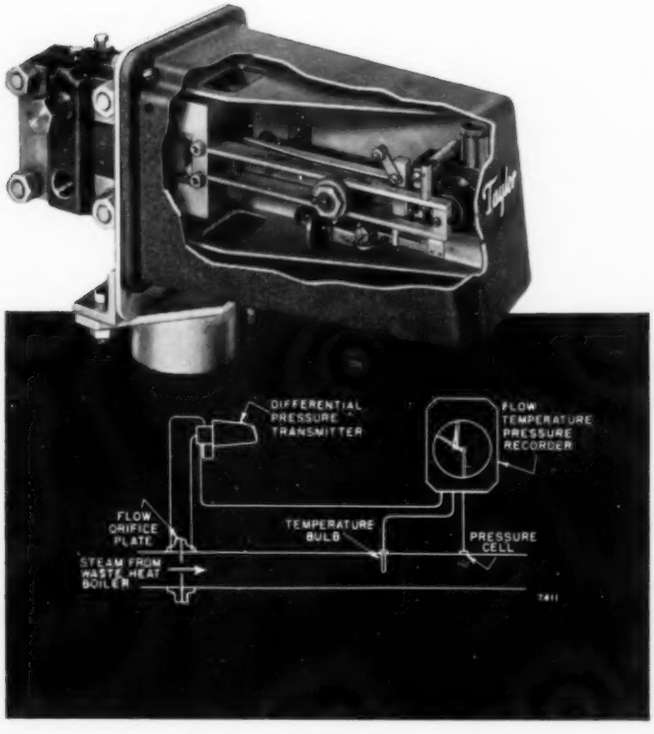

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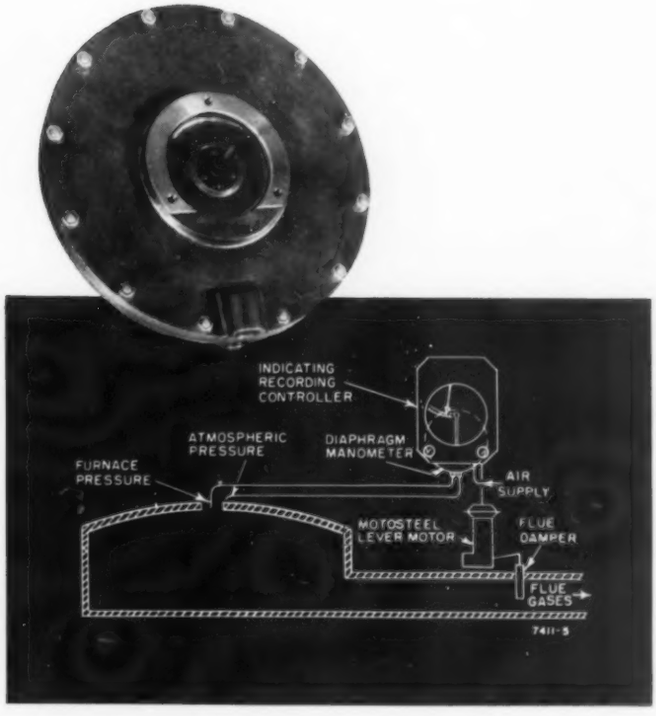

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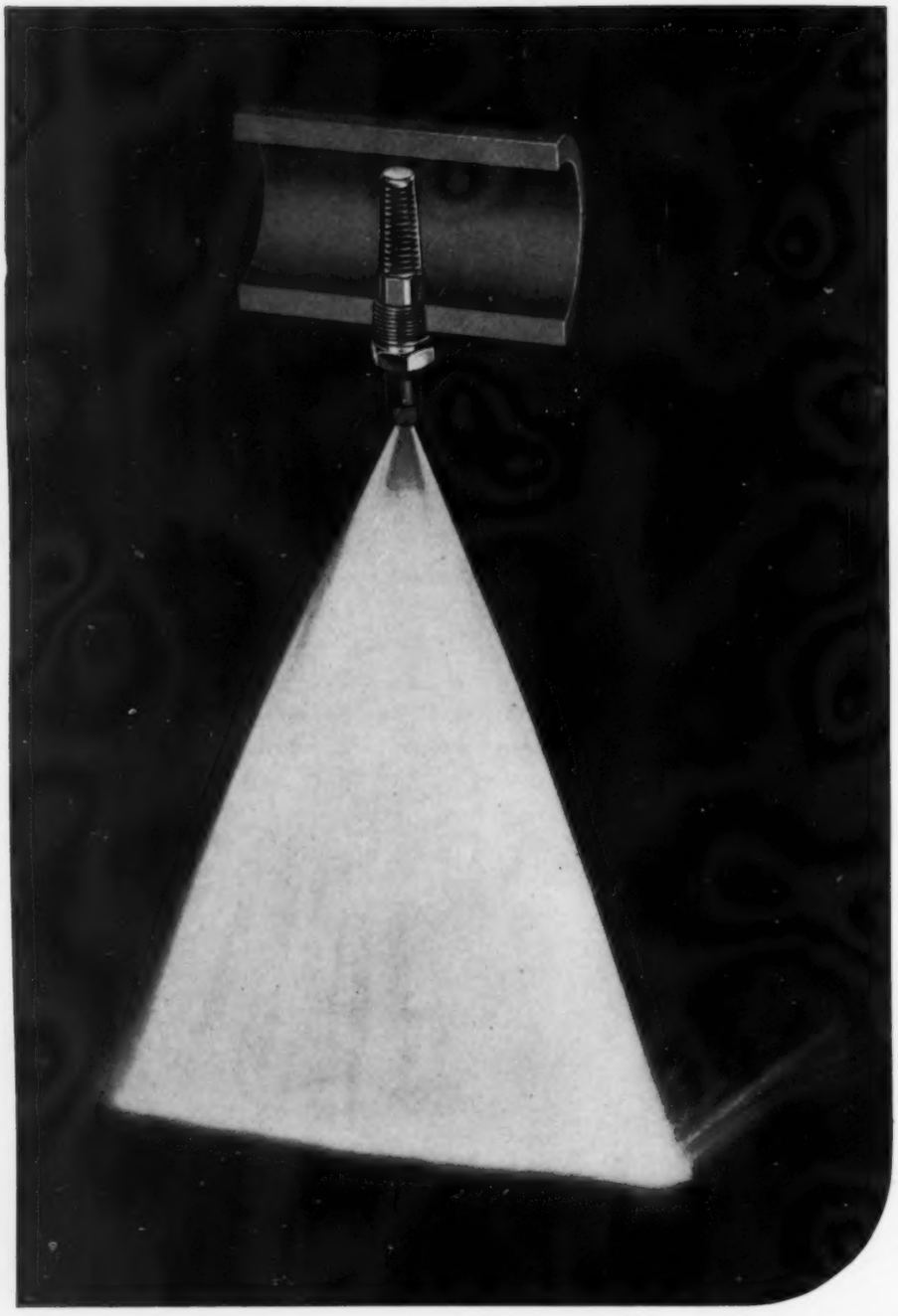

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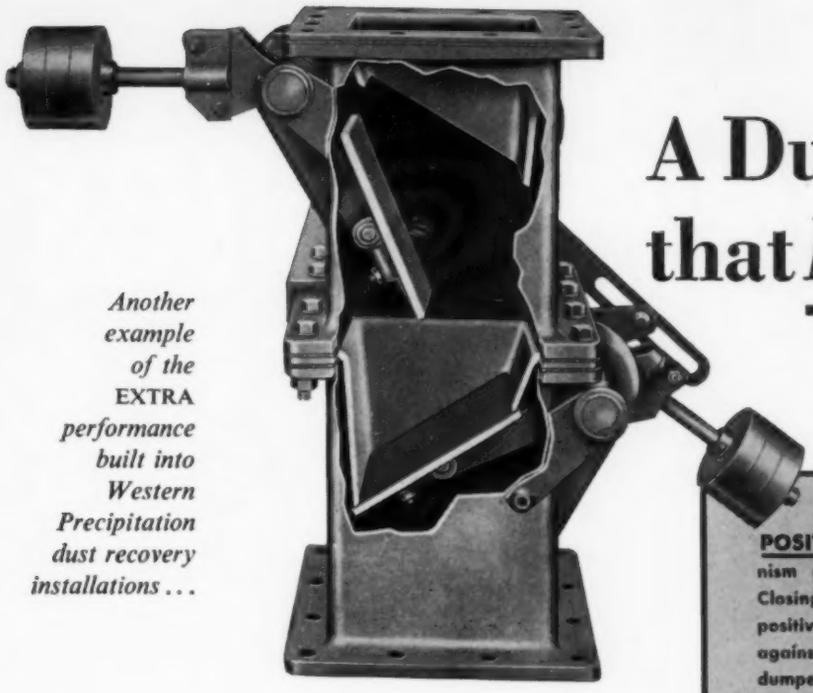

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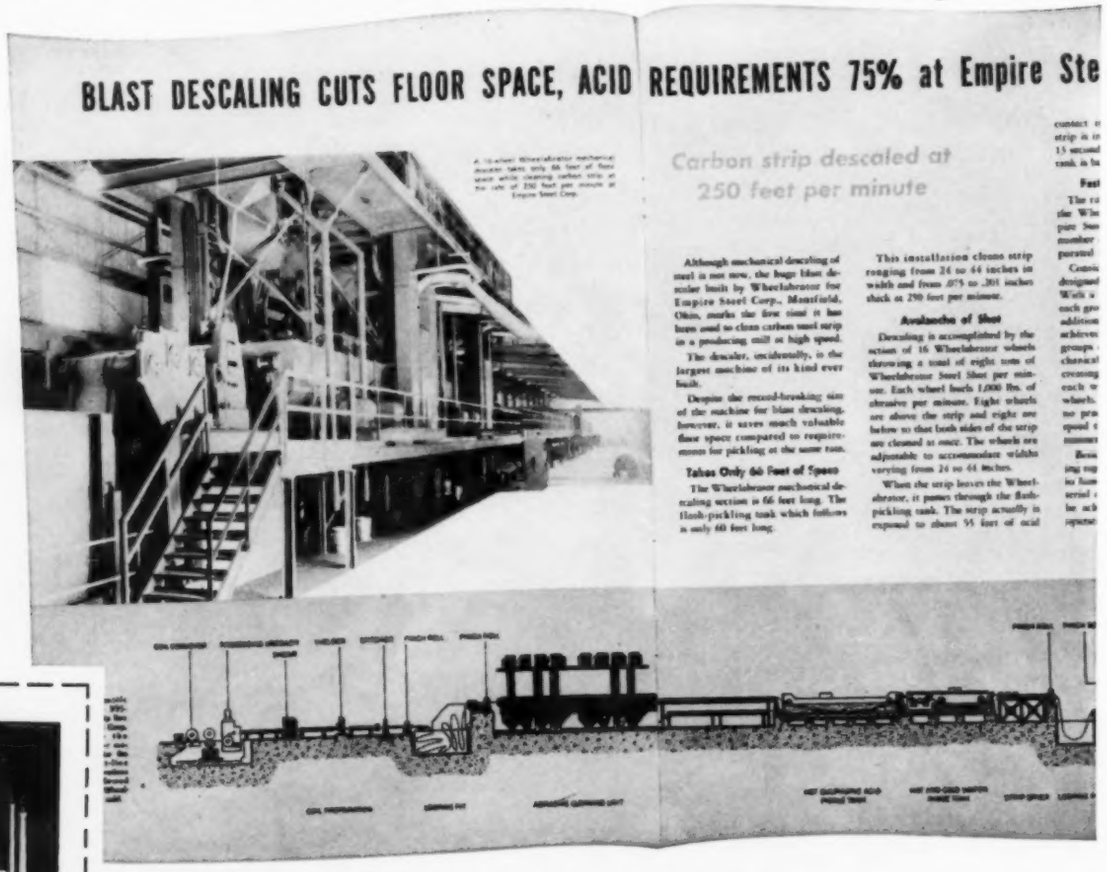
Steel producers and processors are rapidly discovering how Wheelabrator Mechanical Descaling brings savings in time, labor, space and material and results in improved final products. In many installations, mechanical descaling requires only 1/4 as much space as acid pickling. In others, labor requirements are reduced as much as 50%. In still others, Wheelabrating saves not only cleaning time but speeds production by permitting straight-line operation not possible with acid pickling. In addition, Wheelabrating removes no virgin metal, thus saving metal. And elimination or reduction of acid pickling saves on acid requirements and minimizes acid disposal problems and expense. While making all these savings, Wheelabrating also provides a matte finish that has proved superior for cold working.


BLAST DESCALING CUTS FLOOR SPACE, ACID REQUIREMENTS 75% at Empire Ste

Carbon strip descaled at 250 feet per minute

Although mechanical descaling of steel is not new, the huge blast descaler built by Wheelabrator for Empire Steel Corp., Mansfield, Ohio, marks the first time it has been used to clean carbon steel strip in a producing mill at high speed.

The descaler, incidentally, is the largest machine of its kind ever built.

Despite the record-breaking size of the machine for blast descaling, however, it saves much valuable floor space compared to requirements for pickling at the same rate.

Takes Only 66 Feet of Space

The Wheelabrator mechanical descaling section is 66 feet long. The flash-pickling tank which follows is only 60 feet long.

This installation cleans strip ranging from 24 to 64 inches in width and from .075 to .301 inches thick at 250 feet per minute.

Avalanche of Shot

Descaling is accomplished by the action of 16 Wheelabrator wheels throwing a total of eight tons of Wheelabrator Steel Shot per minute. Each wheel hurls 1,000 lbs. of abrasive per minute. Eight wheels are above the strip and eight are below so that both sides of the strip are cleaned at once. The wheels are adjustable to accommodate widths varying from 24 to 64 inches.

When the strip leaves the Wheelabrator, it passes through the flash-pickling tank. The strip actually is exposed to about 95 feet of acid

FOR SPECIFIC EXAMPLES OF SAVINGS send today for your free copy of Bulletin 128-D. Actual case histories of Wheelabrator installations show how savings are achieved. Shown above is a report in this highly-informative, thoroughly-illustrated 8-page bulletin.

WHEELABRATOR
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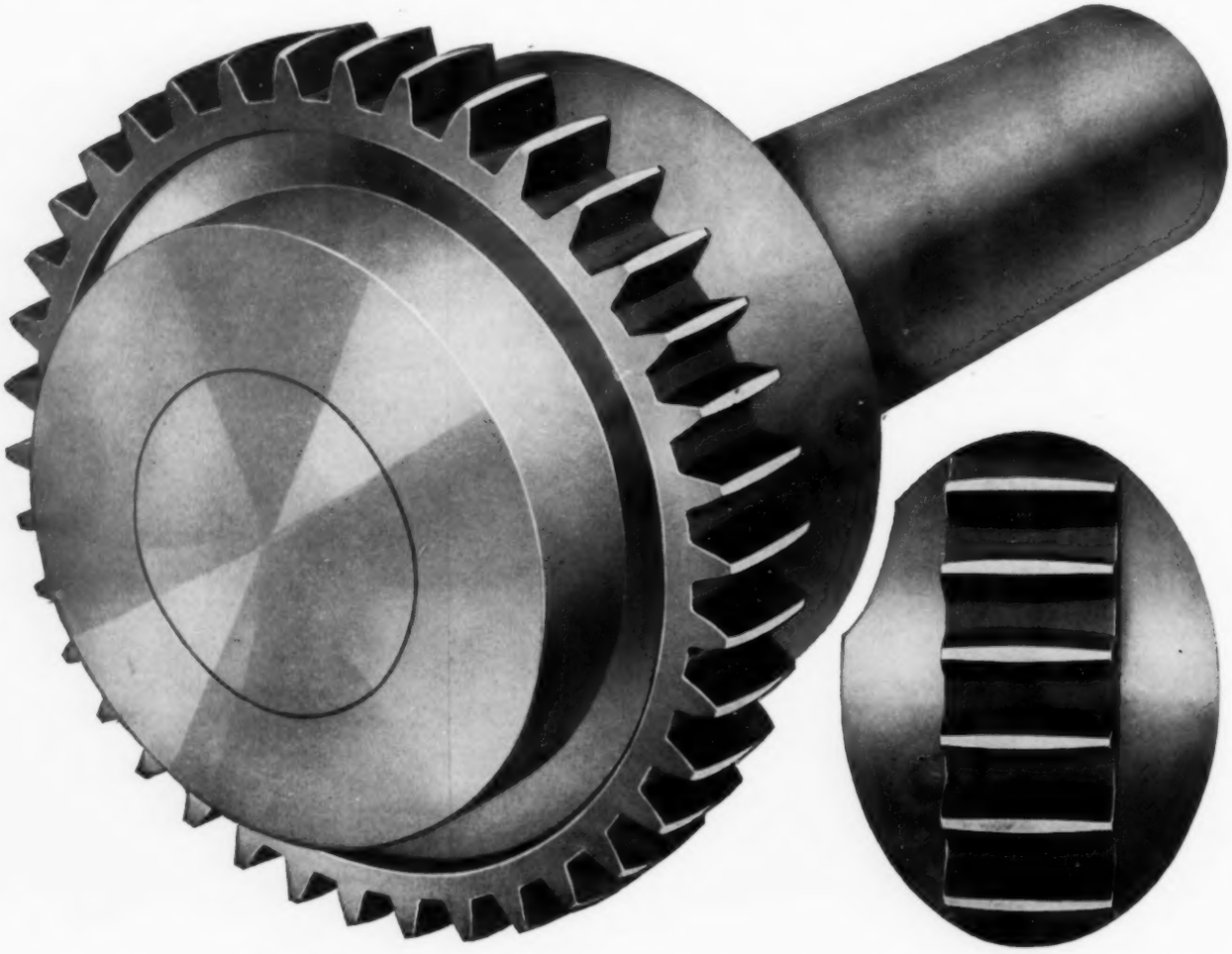

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Studies in Centralized Lubrication
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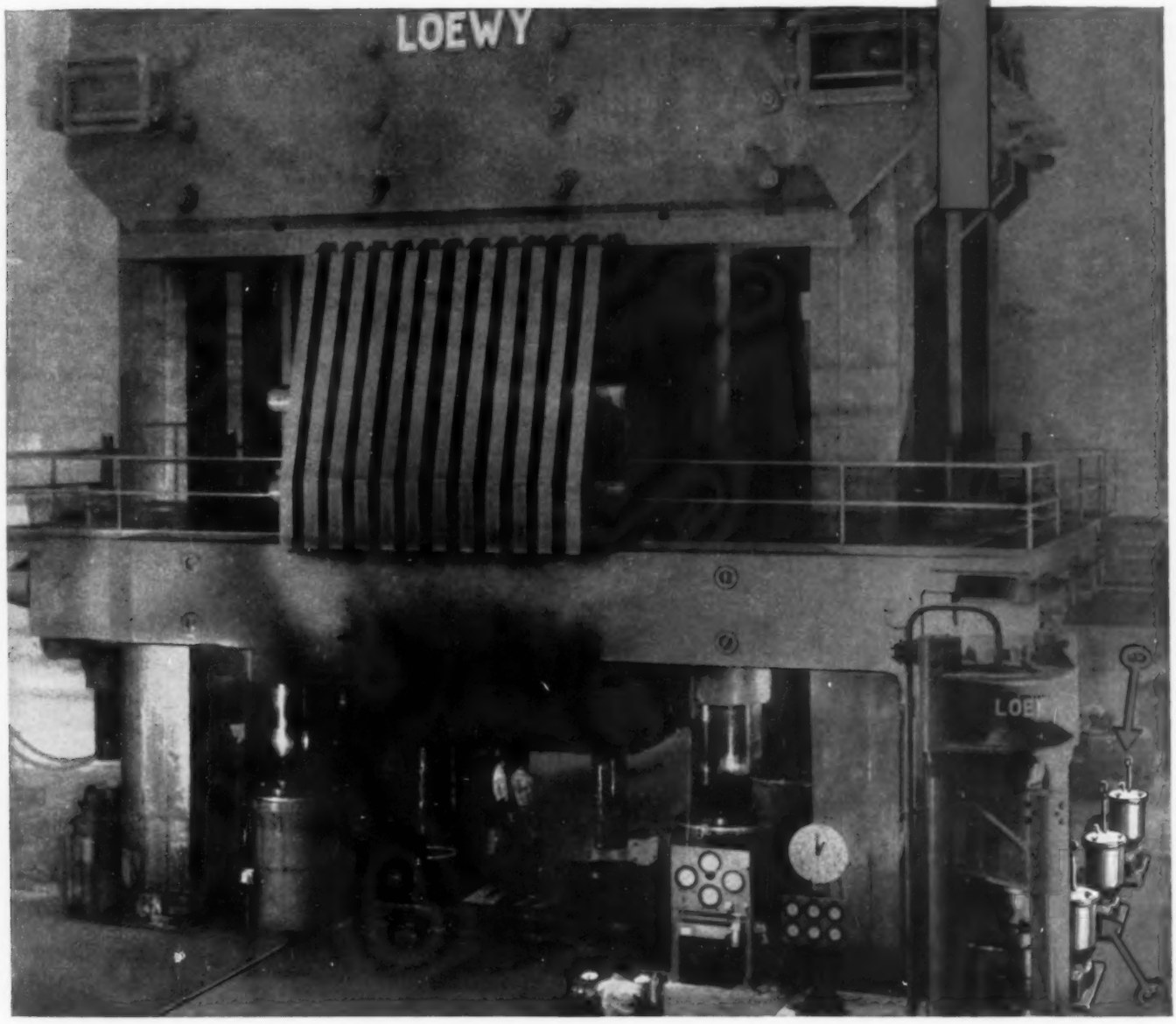

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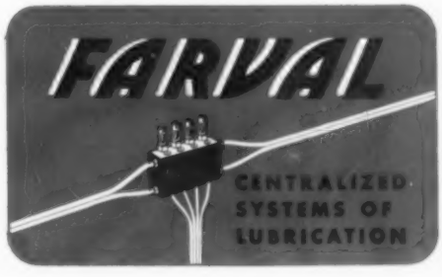

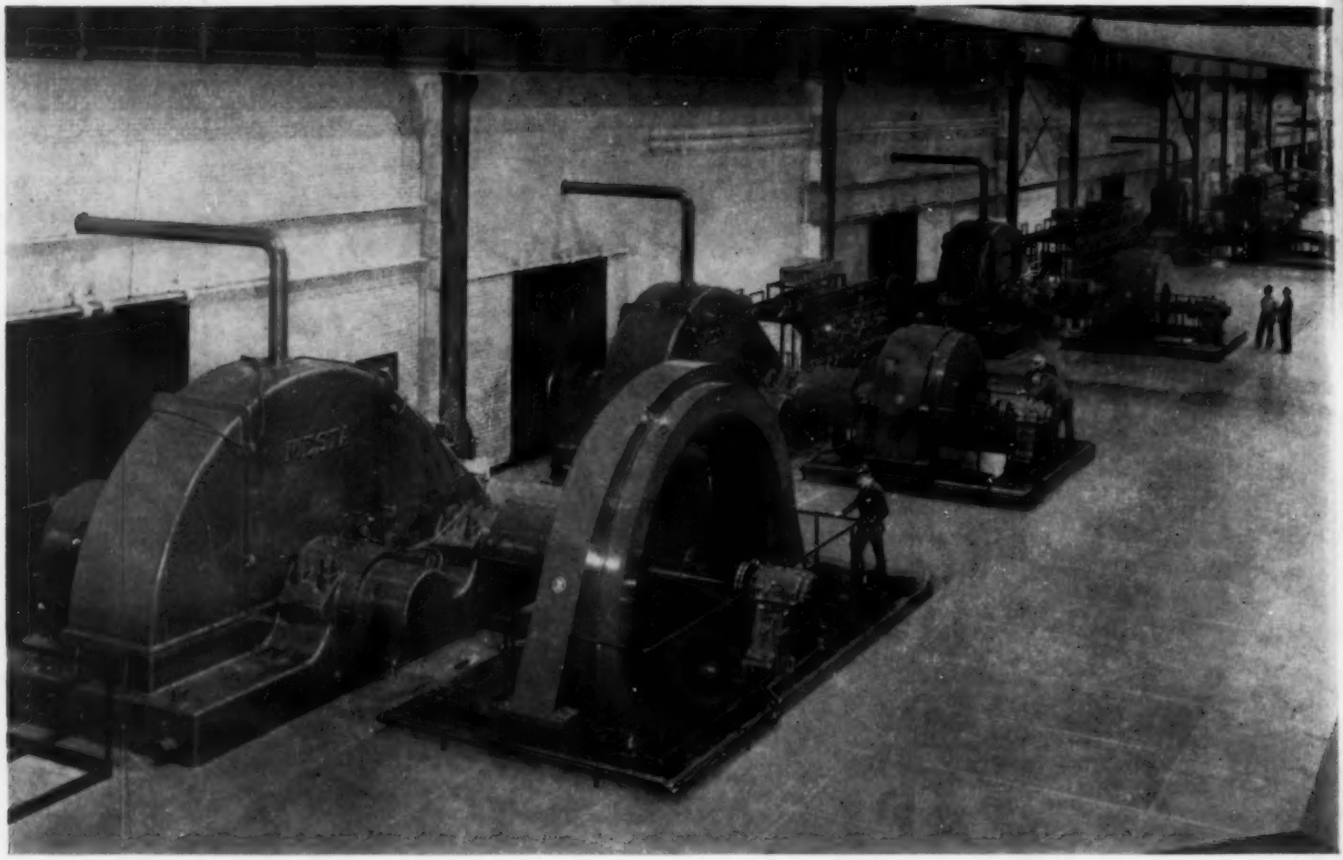

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